

 **PIONEER**

# Service Manual

**CIRCUIT DESCRIPTIONS  
REPAIR & ADJUSTMENTS**



• PL-V70

**ORDER NO.  
ARP-759-0**

**STEREO TURNTABLE**

# PL-V70 (BK)

# PL-L90 (BK)

- This service manual is applicable to the PL-V70/KU and PL-L90/KU.
- PL-L90 is the same as the PL-V70 except for exterior design .

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1. SPECIFICATIONS

Motor and Turntable

|                             |                                       |
|-----------------------------|---------------------------------------|
| Drive System .....          | Belt-drive                            |
| Motor .....                 | DC servo motor                        |
| Turntable Platter .....     | aluminum alloy die-cast               |
| Speeds .....                | 33-1/3 and 45 rpm                     |
| Wow and Flutter .....       | Less than 0.05% (WRMS)                |
|                             | ± 0.065% WTD Peak (DIN)               |
| Signal-to-Noise-Ratio ..... | More than 70 dB (DIN-B)               |
|                             | (with Pioneer cartridge model PC-291) |

Tonearm

|            |                              |
|------------|------------------------------|
| Type ..... | Integrated straight pipe arm |
|------------|------------------------------|

PC-291 Specifications

|                          |                              |
|--------------------------|------------------------------|
| Type .....               | IM type                      |
| Stylus .....             | 0.5 mil diamond (PN-291)     |
| Output Voltage .....     | 2.5 mV                       |
|                          | (1 kHz, 5 cm/s LAT. Peak)    |
| Tracking Force .....     | 1 g to 1.5 g (proper 1.25 g) |
| Frequency Response ..... | 10 to 30,000 Hz              |
| Recommended Load .....   | 50 kΩ                        |
| Weight .....             | 4 g                          |

Subfunctions

Auto lead-in, auto return, auto cut, repeat  
Arm elevation, program search play, manual play,  
Skip, auto disc size selector, record detection,  
Auto speed selector,

Miscellaneous

|                          |   |
|--------------------------|---|
| Power Requirements ..... | AC 120 V, 60 Hz                         |
| Power Consumption .....  | 11W                                     |
| Dimensions .....         | 420 (W) x 104 (H) x 350 (D) mm          |
|                          | 16-1/2 (W) x 4-1/8 (H) x 13-3/4 (D) in. |
| Weight .....             | 7.5 kg/16 lb 8 oz                       |

Accessories

|                              |   |
|------------------------------|---|
| EP Adapter .....             | 1 |
| Remote control cord .....    | 1 |
| Remote control plate .....   | 1 |
| Operating Instructions ..... | 1 |

NOTE:  
Specifications and design subject to possible modification without  
notice, due to improvements.

**QUESTIONNAIRE**

MODEL \_\_\_\_\_

One Model per questionnaire

Dear Servicer,

Thank you for your cooperation in the post-sale service of Pioneer products.

This questionnaire is used as a tool to improve the serviceability of our products and service manuals. Please evaluate this model and service manual by answering the following questions. Your ideas may be realized in our future products. Your answers will be appreciated. Thank you.

PIONEER ELECTRONIC CORP.

T. Nakagawa, Manager, Service Section, International Division

**1. SERVICING EVALUATION**

Circle applicable number:

Good

Fair

Poor

a. Disassembly/Re-assembly:

1    2    3    \*4    \*5

b. Circuit Checks:

1    2    3    \*4    \*5

c. Replacement of Parts:

1    2    3    \*4    \*5

d. Adjustment (s):

1    2    3    \*4    \*5

\* If (4) or (5) was circled, please be specific.

e. Your advice, opinion or ideas related to servicing this product.

## 2. SERVICE MANUAL EVALUATION

a. Circuit & Mechanism Description

b. Circuit Diagram

## 3. OTHER

Please describe other areas of servicing which you may find difficult.

Completed by :

Date :

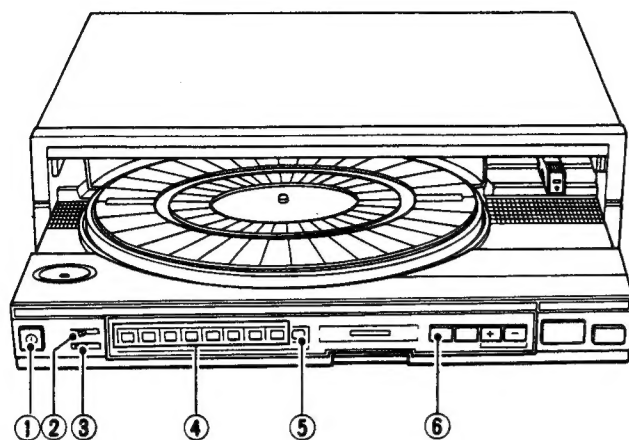
Company Name :

Address :

City/State/Zip :

Please send this form filled to the distributor in your country.

## 2. FRONT PANEL FACILITIES



### ① POWER switch/indicator

Press this switch to turn the power on and off.  
 [ON] (depressed position) : Power is switched ON.  
 [STAND-BY] (released position) : Power is switched OFF.

### ② SPEED switch

Set this switch in accordance with the speed of the record to be played.

[AUTO]: Automatically sets rotation speed in accordance with the size of the record: Rotates at 33-1/3 rpm with 30 cm and 25 cm records. Rotates at 45 rpm with 17 cm records.

[33]: Rotates at 33-1/3 rpm

[45]: Rotates at 45 rpm

### ③ SENSOR switch

Depending on the type of record being played, this switch may be used to adjust the sensitivity at the time of programmed play.

Normally the switch should be left in [NOR] position.

[NOR]: For normal records.

[HI]: For records with very narrow intervals between tracks.

[LO]: For records with wide sound-groove pitch.

### ④ PROGRAM switches (1 — 8)/indicators

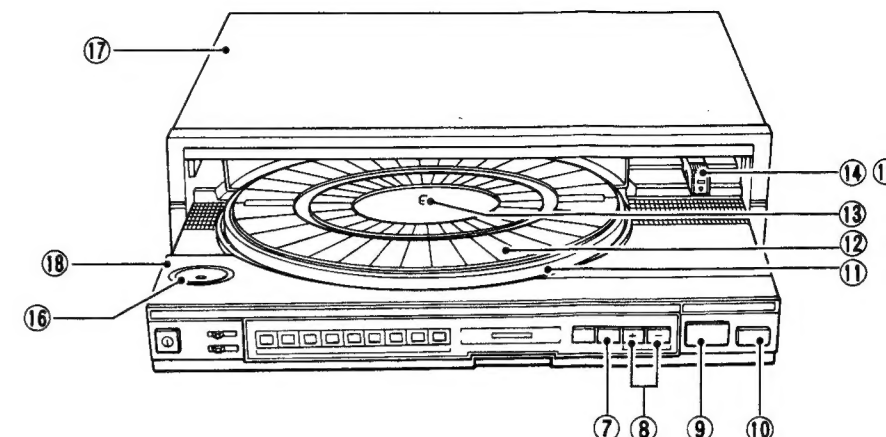
- Press these switches in the desired sequence from [1] through [8] when programming the order in which the tracks are to be played. The tracks are programmed in the order in which the switches are pressed, and auto play or repeat play is performed.
- The numbers [1] through [8] indicate the order of the tracks on the record (for instance, the [2] switch corresponds to the second track). During programmed playback, the program indicator corresponding to the track presently being played will flash.

### ⑤ CLEAR switch

This switch is pressed in order to clear the program.

### ⑥ REPEAT switch/indicator

Press this switch so that the indicator lights for repeat play.



### ⑦ ARM ELEVATION switch (ARM EV)/indicator

- Use the switch for manual play.
- Use the switch to suspend record play temporarily.
- Use the switch when changing the tracks during manual play.

Indicator lights:

The tonearm rises (the stylus moves away from the record).

Indicator flashes:

During right or left movement of the tonearm (or during search for programmed play).

Indicator goes out:

The tonearm descends (the stylus is lowered onto the record).

### ⑧ LOCATE/SKIP switches (ARM LOCATE/PROGRAM SKIP)

Use these switches to start manual playback, or during playback to change the track being played. When the switches are pressed, the tonearm will move to the right or left (the arm elevation indicator will flash).

[<, +]: Tonearm moves to left. During programmed play, moves to the next programmed track. If pressed multiple times, moves ahead the number of tracks corresponding to the number of times the switch is pressed.

[>, -]: Tonearm moves to right. During programmed play, moves back to the beginning of the track presently being played. If pressed multiple times, moves back the number of tracks corresponding to the number of times the switch is pressed.

NOTE:

When pressing these switches two or more times during programmed play to skip over two or more tracks, do not allow more than about one second to elapse between each press of the switch.

### ⑨ PLAY/STOP switch

Press this switch when starting auto play or when stopping play.

### ⑩ EJECT button

Press when mounting or removing a record. When pressed, the slide base comes out to the front.

### ⑪ Platter

### ⑫ Platter mat

### ⑬ Platter shaft

### ⑭ Tonearm

### ⑮ Cartridge (PC-291)

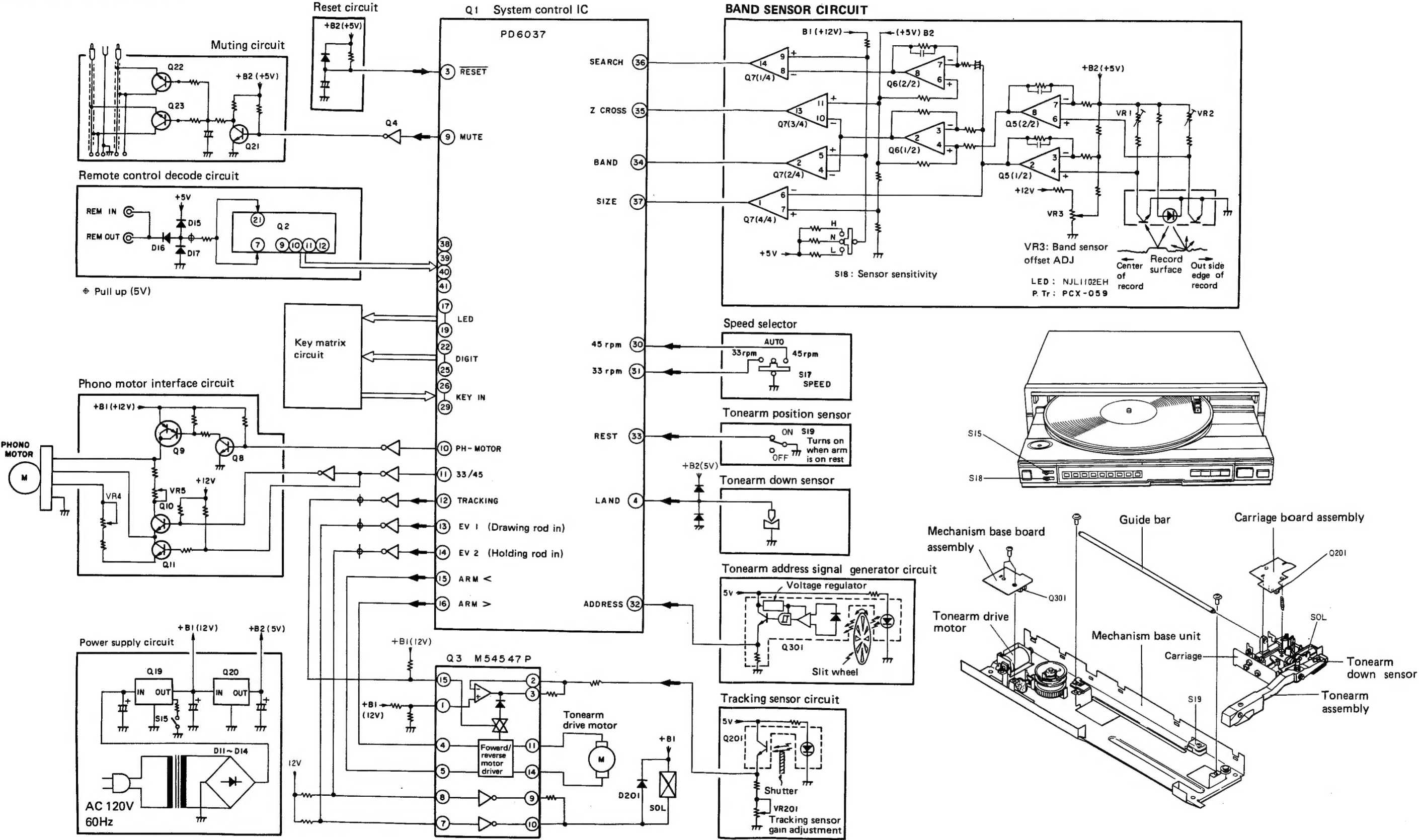
### ⑯ EP adapter

This is used when playing 45 rpm records with a large center hole.

### ⑰ Cabinet

### ⑱ Slide base

3. BLOCK DIAGRAM



## 4. CIRCUIT DESCRIPTIONS

### 4.1 CIRCUIT DESCRIPTIONS

#### 4.1.1 Address Sensor Circuit

The address sensor is located on the mechanism base unit. It detects the position of the tonearm and sends address pulses to the control IC as the tonearm moves. The address sensor is made up of an internal Schmitt trigger circuit photo interrupter and a slit wheel which is synchronized with the carriage. The slit wheel spins when the carriage moves and intermittently cuts off light to the photo interrupter (Q301) in pulses which correspond to the carriage movement. These pulses are counted by the control IC, which detects the distance the carriage moves, the tonearm lowering position and the end of the record. It also registers band addresses.

The address pulses from the photo interrupter work as follows: When the light is cut off, the output is "L," and when the light is not cut off the output is "H." One address signal pulse is approximately equivalent to 0.114 mm of tonearm movement.

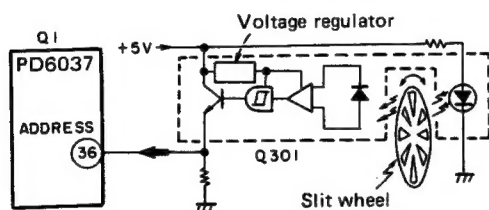


Fig. 4-1 Address Sensor Circuit

#### 4.1.2 Tracking Sensor Circuit

This circuit detects tracking errors by means of a shutter which is synchronized with the tonearm and a photo interrupter.

The tracking sensor is made up of a shutter synchronized with the tonearm and a photo interrupter which is mounted onto the carriage base board. When the tonearm lowers and begins tracing the record surface the tonearm tracking errors increase as the number of rpms increases. When tracking errors increase, the shutter, which is synchronized with the tonearm, also moves and the light cut-off rate of the photo interrupter changes. Subsequently, the output of the photo interrupter changes and is sent to the tonearm drive unit in the form of tracking error signals.

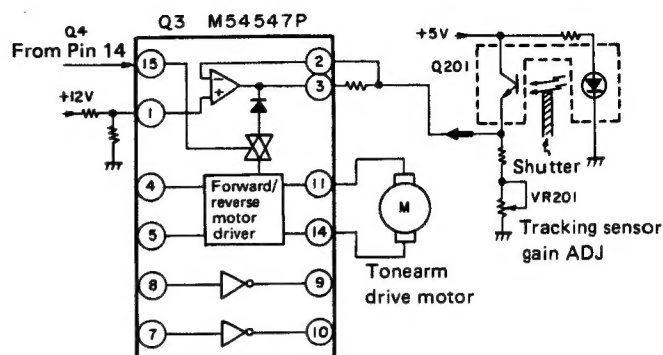


Fig. 4-2 Tracking sensor circuit

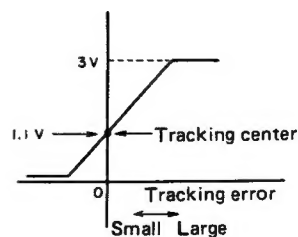
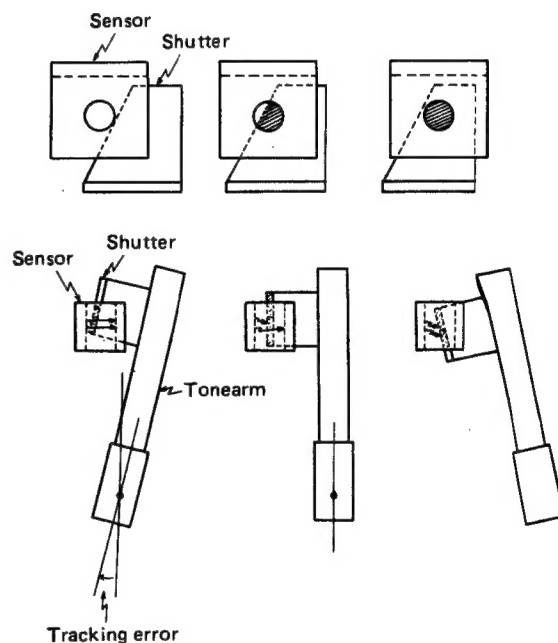


Fig. 4-3 Detection of tracking errors

### 4.1.3 Band Sensor Circuit

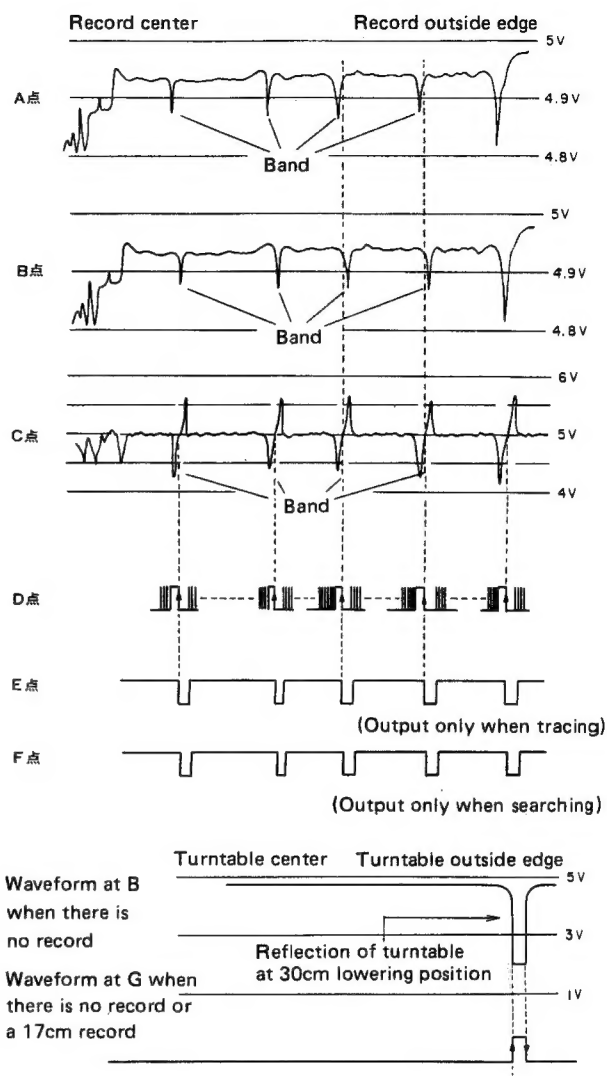
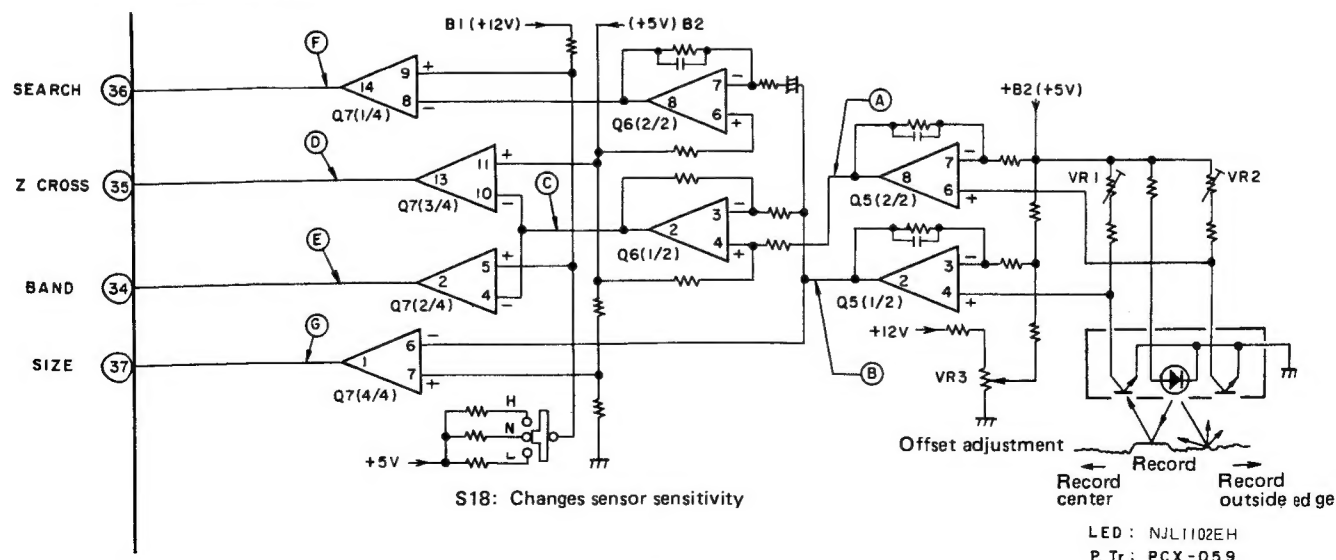
The band sensor circuit detects the size of the record and width of bands by means of a band sensor. It is made up of a band sensor, an amplifier, a differential amplifier, a zero cross comparator, a band comparator, a 30 cm size comparator, an AC amplifier, and a search comparator.

The band sensor itself is made up of an array of 2 phototransistors (PCX-059) mounted into the headshell of the tonearm and an infrared LED (NJL1102EH). It detects, with a light sensor, the different rates of light reflection to determine the difference between a sound groove and a plain band. The output of the band sensor is amplified by each of the amplifiers and applied to the differential amplifier to be transformed into a waveform like that of point C in figure 4-5. From the differential amplifier output, the zero cross comparator detects a band signal (zero cross point), and the band comparator detects signals whose potential is less than Q6 (3/3) pin 8 as band signals.

The output from the band sensor is also applied to the AC amplifier and the 30 cm size comparator.

When in the search mode with the tonearm up, the band sensor output is applied through the AC amplifier (band pass filter configuration) and the search comparator and transformed into the waveform shown in F in figure 4-5. This signal is applied to the control IC to register the plain bands on the record.

The 30 cm size comparator, on receiving the amplified output from the band sensor and detecting reflection from the turntable at the 30-cm lowering position, determines that the record is not a 30-cm record, and sends the signal shown in G in figure 4-5 to the control IC.



#### 4.1.4 Elevation and Tonearm Circuits

The tonearm drive motor and EV solenoid are controlled by commands from the control IC (Q1), which also controls the horizontal and vertical movement of the tonearm. In addition to this, the IC controls tonearm tracking with the tracking sensor and tracking error signals.

##### • EV solenoid drive

The EV solenoid drive uses a large current at first to draw the plunger inside, and thereafter uses a lower current for holding the plunger in.

The signal to draw the plunger inside comes from the control IC (Q1), passes through the Q2 transistor array, and enters Q3 pin 7. This signal turns on the Q3 Darlington transistor, and approximately 170mA of current runs into the collector, turning on the EV solenoid which draws the plunger inside. Because of this, the tonearm will drop slightly. This "draw" signal from the control IC lasts about 1 second. Next, the hold signal, which was output at the same time as the draw signal, passes through the Q2 transistor array, enters Q3 pin 8 and turns on the Darlington transistor. When the draw signal ends, a current of approximately 70mA drawn from pin 9 holds the plunger inside, which keeps the tonearm elevation down until the hold signal ends.

##### • Tonearm drive

The tonearm drive is controlled by input to Q3 pin 4, pin 5 and pin 15. Their truth values are shown in Fig. 4-6.

##### • Lead-in (locate-in) <

Q3 receives locate-in signals from the control IC (Q1), and with an output of approximately 0V from Q3 pin 14 (O1) and approximately 11V from pin 11 (O2), the tonearm motor begins turning in the lead-in direction.

##### • Lead-in (locate-out) >

Q3 receives locate-out signals from the control IC (Q1), and with an output of approximately 11V from pin 14 and approximately 0V from pin 11, the tonearm motor begins turning in the lead-out direction.

##### • Stop

Q3 receives stop signals from the control IC (Q1), and with an output of approximately 0V from both pin 14 and pin 11, stops the tonearm motor.

##### • Tracking

Q3 receives tracking signals from the control IC (Q1), and between pin 14 and pin 11, outputs an amplified tracking error signal (amplified by an internal OP amplifier) and begins turning the tonearm drive motor in such a way as to correct the error.

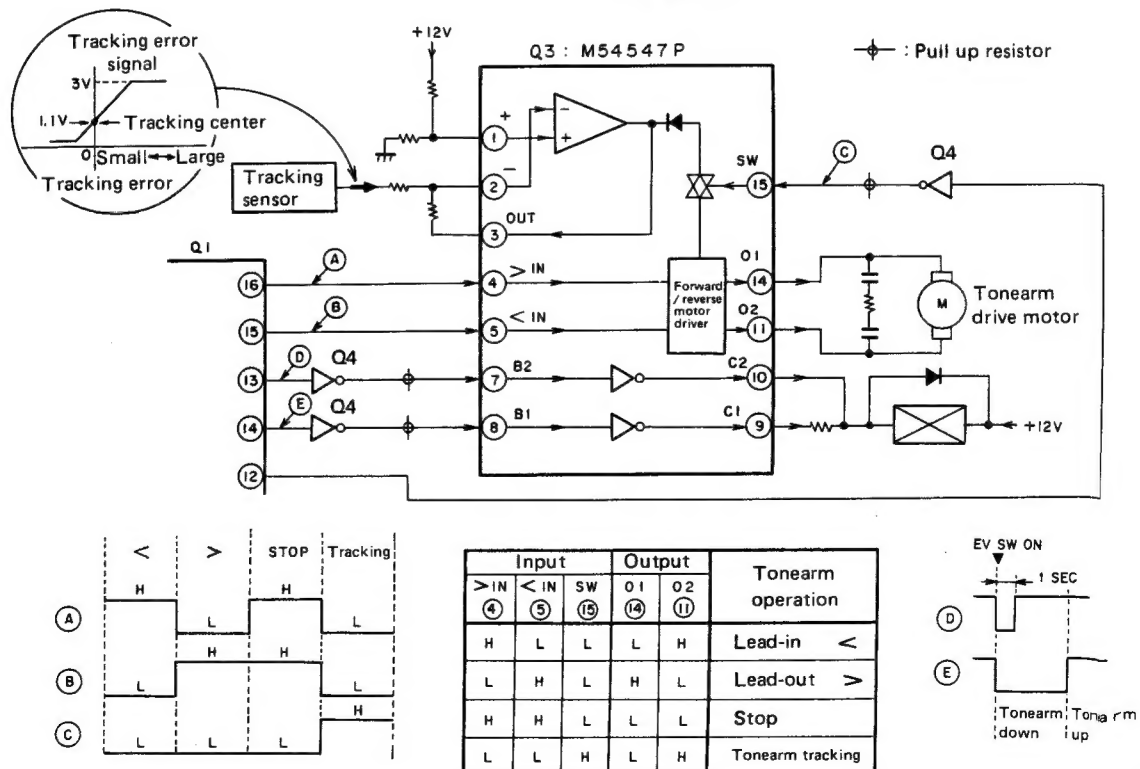


Fig. 4-6 Elevation and Tonearm Drive Circuit and I/O Truth Value Chart

4.1.5 Key Matrix Circuit

The key matrix circuit reads the digit output (pins 22 to 25) of the control IC (Q1) from the Key IN terminal (pins 26 to 29) and distinguishes different key input signals with the control IC. In addition to carrying out key input operations, it

lights LEDs with output from pins 17 to 19. Fig. 4-8 shows the output waves produced by switch matrix input in the following order: REPM SW, Program SW 7, and EV SW.

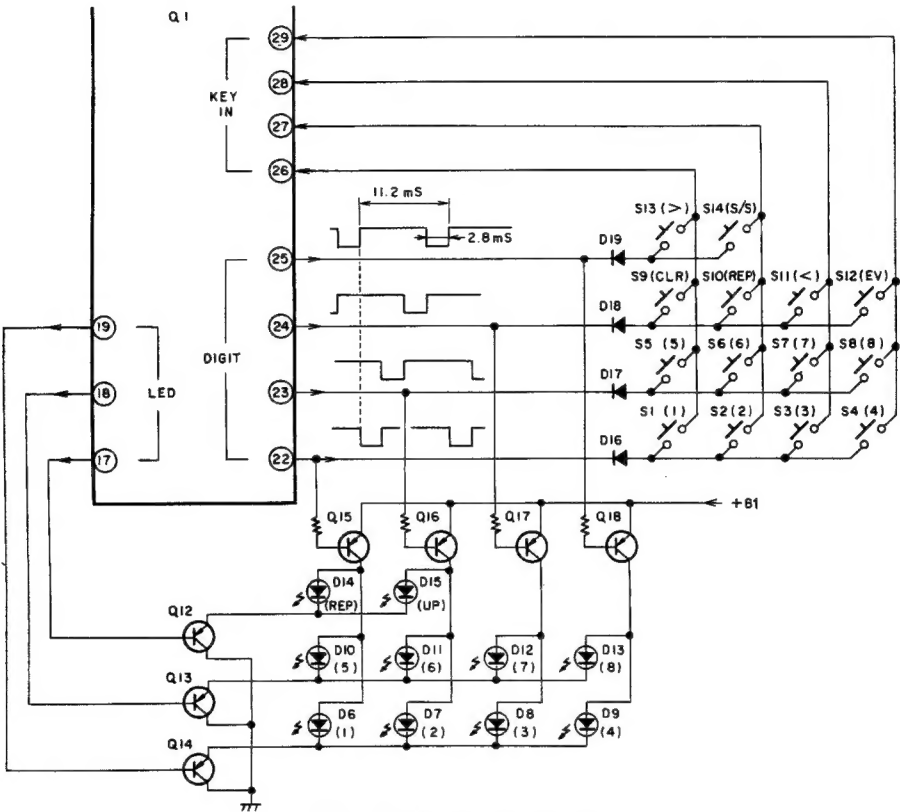


Fig. 4-7 Key Matrix Circuit

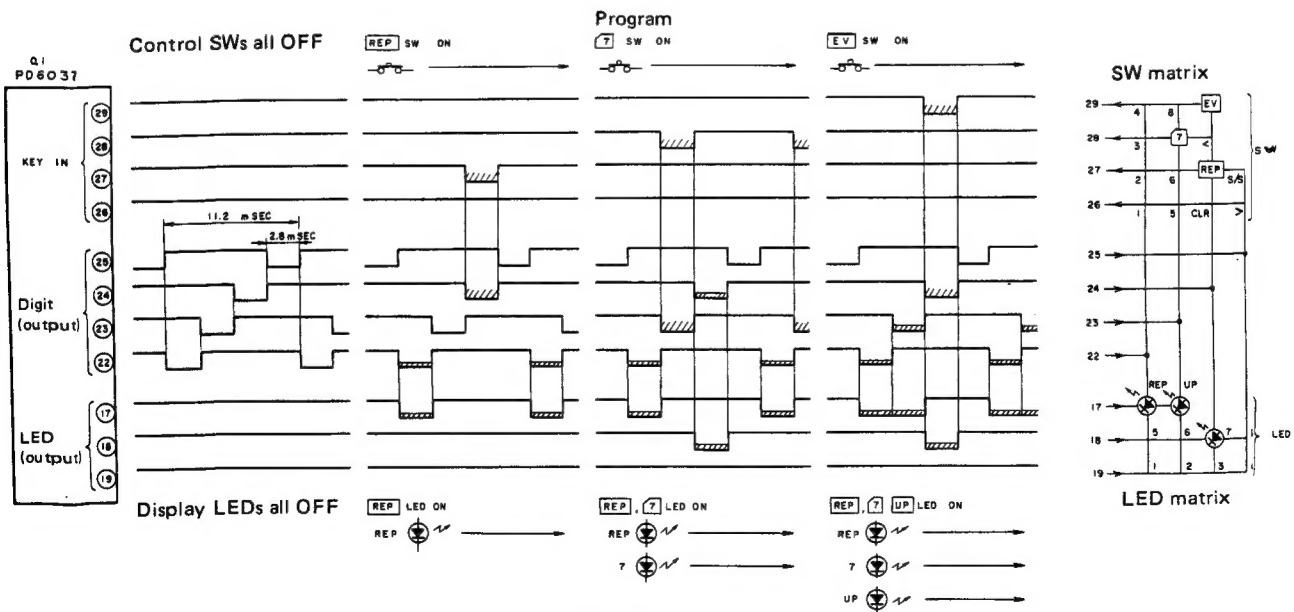


Fig. 4-8 Output Waveforms Produced by Key input

#### 4.1.6 Remote Control Decode Circuit

##### Remote control signal processing feature

- The SA-V70 receives an infrared remote control signal from the commander, removes the carrier, and sends the resulting signal through an 1P remote control cord to the REM IN terminal of the PL-V70.

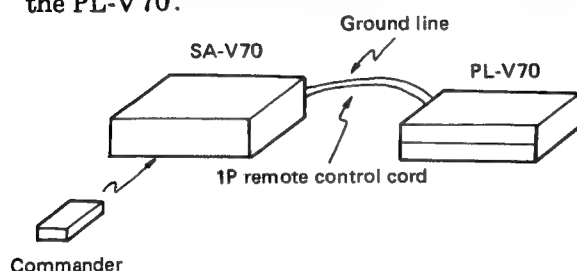


Fig. 4-9 Connection to REM IN

- When a predefined serial signal is input to the REM IN terminal, the operation dictated by the key strokes is performed, and the mechanism and the signal lines are thus controlled.

- Input conditions (Input signal must be without a carrier)
  - The signal format must conform to that of  $\mu$ PD6102G. (See figure 4-11.)
  - Only when a custom code (component code; A3 for the player) specified for the REM IN terminal is received, shall the unit respond the following control codes (instruction codes).
  - Remote control signals can be received depending on the reception mode (enable/disable) of the main unit. When both a remote control key and a main unit key are pressed at the same time, the main unit key becomes effective.

##### 2. Input processing

- The trailing edge of the input signal at the REM IN terminal is detected.
- The duration of the leader code ("L" level) determines the validity of the leader code. (Approximately 12.3 msec)
- The states ("1" or "0") of the custom and data codes are determined by the width of the data pulses. (0: approx. 1.02 msec; 1: approx. 2.05 msec)

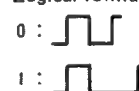
##### 3. Control processing

- When the remote control signal is valid, the unit enters one of the 15 control modes described in figure 4-12.
- The remote control operation must be exactly the same as the operation instructed via the unit's keys.
- Even while the remote operation proceeds, the unit shall keep checking whether the signal is still received at the REM IN terminal. If the signal ceases for 100 msec or more, the unit shall go into the standby mode in which it waits for another remote control signal.
- If the first data in the remote control signal is invalid, a second data is observed. If the second data is valid, it is used for remote control.
- If the second data is also invalid, a third data is observed ... and so forth.
- If valid data are received successively, control codes corresponding to the data are output successively.

##### Custom code

|      | C0 | C1 | C2 | C3 | C4 | C5 | C6 | C7 |
|------|----|----|----|----|----|----|----|----|
| (A3) | 1  | 1  | 0  | 0  | 0  | 1  | 0  | 1  |

##### Logical format



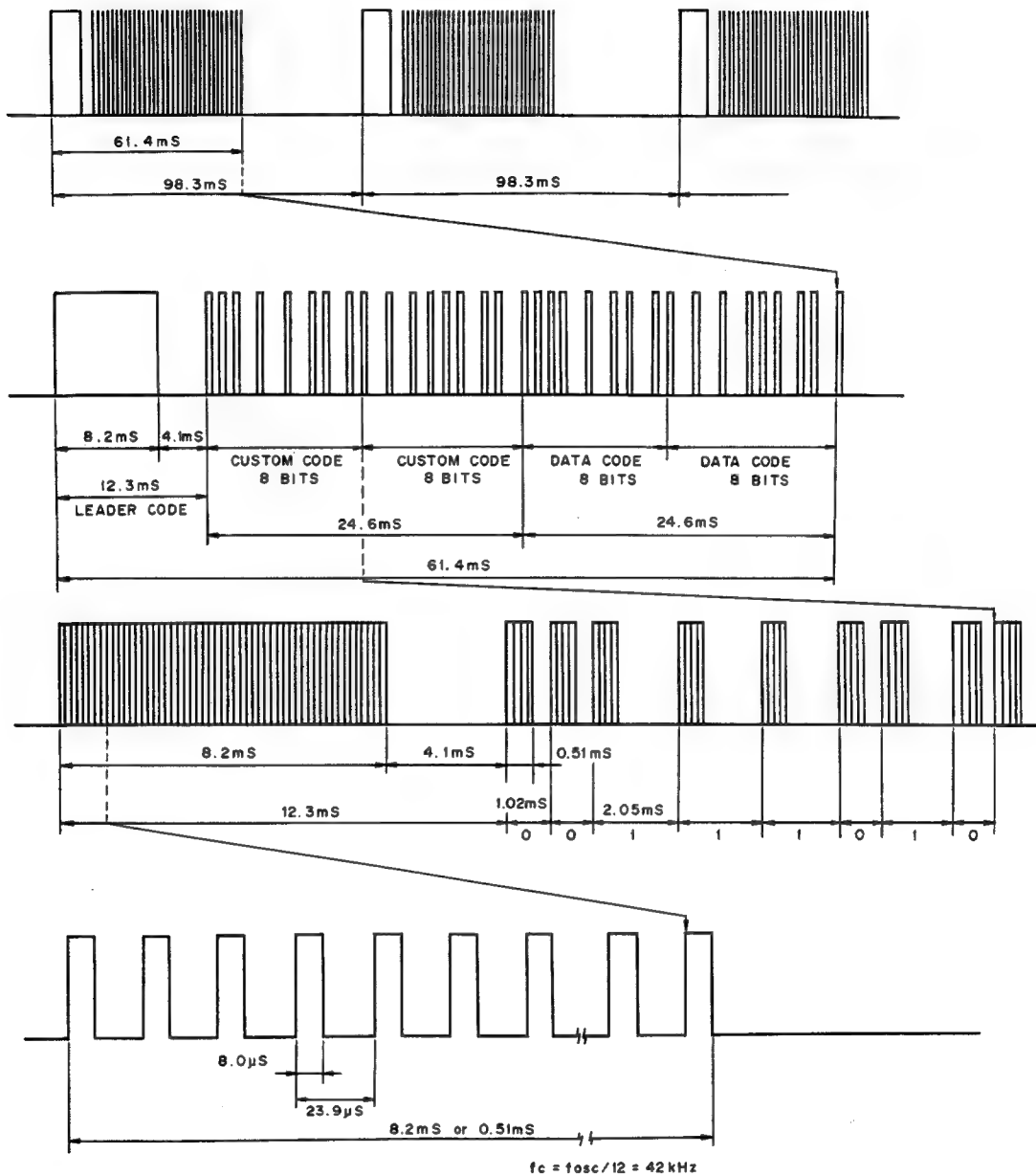
The states ("1" or "0") of the custom and data codes are determined by the width of the data pulses.

##### Data code

|     | D0 | D1 | D2 | D3 | D4 | D5 | D6 | D7 | Control mode | Notes (HEX code) 012 |
|-----|----|----|----|----|----|----|----|----|--------------|----------------------|
| K2  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1            | (01)                 |
| K3  | 0  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 2            | (02)                 |
| K4  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 3            | (03)                 |
| K5  | 0  | 0  | 1  | 0  | 0  | 0  | 0  | 0  | 4            | (04)                 |
| K6  | 1  | 0  | 1  | 0  | 0  | 0  | 0  | 0  | 5            | (05)                 |
| K7  | 0  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 6            | (06)                 |
| K8  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 7            | (07)                 |
| K9  | 0  | 0  | 0  | 1  | 0  | 0  | 0  | 0  | 8            | (08)                 |
| K17 | 0  | 0  | 0  | 0  | 1  | 0  | 0  | 0  | SKIP+        | (10)                 |
| K18 | 1  | 0  | 0  | 0  | 1  | 0  | 0  | 0  | SKIP-        | (11)                 |
| K23 | 0  | 1  | 1  | 0  | 1  | 0  | 0  | 0  | STOP         | (16)                 |
| K24 | 1  | 1  | 1  | 0  | 1  | 0  | 0  | 0  | START        | (17)                 |
| K25 | 0  | 0  | 0  | 1  | 1  | 0  | 0  | 0  | ARM          | (18)                 |
| K37 | 0  | 0  | 1  | 0  | 0  | 0  | 1  | 0  | REP          | (44)                 |
| K38 | 1  | 0  | 1  | 0  | 0  | 0  | 1  | 0  | CLEAR        | (45)                 |

Fig. 4-10 Remote Control Signal Codes

# ● Format



# ● Data structure

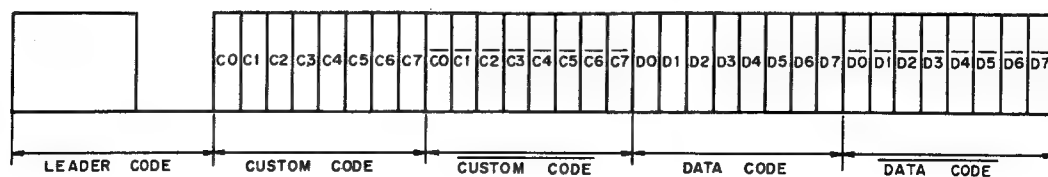


Fig. 4-11 Format and Data Structure of the Remote Control Signal

## Check Mode of the Remote Controller Decoder Section

1. Remove the casing from the PL-V70.
2. Ground pin 6 (REM) of connector CN4, and turn the power on. (This makes the remote signal receiver unit of the remote control commander unnecessary.)
3. Every time the REM IN (JK1) terminal or REM OUT (JK2) terminal is grounded, the LEDs turn on or off as follows:

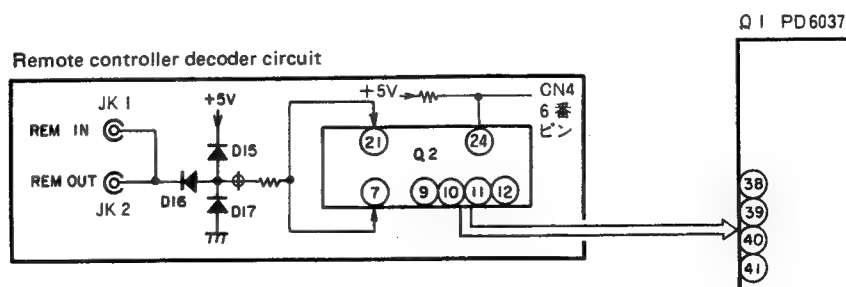
- ```

→ Program 1 LED turns on → Program 2 LED
turns on → Program 3 LED turns on →
Clear (LED turns off)

```

| Commander<br>input key | Output logic of PDE003 |    |    |    |
|------------------------|------------------------|----|----|----|
|                        | 9                      | 10 | 11 | 12 |
| 1                      | L                      | L  | L  | L  |
| 2                      | L                      | L  | L  | H  |
| 3                      | L                      | L  | H  | L  |
| 4                      | L                      | L  | H  | H  |
| 5                      | L                      | H  | L  | L  |
| 6                      | L                      | H  | L  | H  |
| 7                      | L                      | H  | H  | L  |
| 8                      | L                      | H  | H  | H  |
| SKIP +                 | H                      | L  | H  | L  |
| SKIP -                 | H                      | H  | L  | L  |
| STOP                   | H                      | H  | H  | L  |
| START                  | H                      | H  | L  | H  |
| ARM                    | H                      | L  | H  | H  |
| REP                    | H                      | L  | L  | H  |
| CLEAR                  | H                      | L  | L  | L  |
| No input               | H                      | H  | H  | H  |

**Fig. 4-12**



**Fig. 4-13 Remote Controller Decoder Circuit**

● Functions of PDE003 pins

| Pin No. | Symbol | I/O    | Pin name     | Description                                                       |                           | Notes                             |
|---------|--------|--------|--------------|-------------------------------------------------------------------|---------------------------|-----------------------------------|
| 1       | PD0    | Output | REP          | Individual output (Valid only when the component code is A3.)     | OFF ON                    | "H" when in standby mode.         |
| 2       | PD1    | Output | ARM          | Individual output (Valid only when the component code is A3.)     | OFF ON                    |                                   |
| 3       | PD2    | Output | STOP         | Individual output (Valid only when the component code is A3.)     | OFF ON                    |                                   |
| 4       | PD3    | Output | START        | Individual output (Valid only when the component code is A3.)     | OFF ON                    |                                   |
| 5       | Extal  | Input  | —            | Clock input, pin for external oscillator.                         |                           | Ceramic oscillator, 800kHz.       |
| 6       | Xtal   | Input  | —            |                                                                   |                           |                                   |
| 7       | INT    | Input  | REM IN I     | Connected to pin 22 (REM IN II), receives remote control signals. |                           |                                   |
| 8       | RESET  | Input  | —            | Initial reset input.                                              | Reset                     |                                   |
| 9       | PE0    | Output | DATA L0      | Decode data output pin.                                           |                           | "H" when in standby mode.         |
| 10      | PE1    | Output | DATA L1      |                                                                   |                           |                                   |
| 11      | PE2    | Output | DATA L2      |                                                                   |                           |                                   |
| 12      | PE3    | Output | DATA L3      |                                                                   |                           |                                   |
| 13      | TEST   | —      | —            | Grounded.                                                         |                           |                                   |
| 14      | Vss    | —      | —            | Grounded.                                                         |                           |                                   |
| 15      | PF0    | Output | DATA H0      | Decode data output pin.                                           |                           | "H" when in standby mode.         |
| 16      | PF1    | Output | DATA H1      |                                                                   |                           |                                   |
| 17      | PF2    | Output | DATA H2      |                                                                   |                           |                                   |
| 18      | PF3    | Output | DATA H3      |                                                                   |                           |                                   |
| 19      | PG0    | Output | ANS. LED     | Output for indicating "Data being output".                        | Standby Data being output | Equivalent to KEY STROBE          |
| 20      | VDD    | —      | —            | +5V                                                               |                           |                                   |
| 21      | PA0    | Input  | REM IN II    | Connected to REM In I, receives remote control signals.           |                           | Remote control signal             |
| 22      | PA1    | Input  | COMPO I      | Pin for setting component code.                                   |                           | Valid only at initial reset time. |
| 23      | PA2    | Input  | COMPO II     | Pin for setting component code.                                   |                           | Valid only at initial reset time. |
| 24      | PA3    | Input  | DECODE/CHECK | Pin for switching decode/check mode.                              | DECODE CHECK              | Valid only at initial reset time. |
| 25      | PC0    | Output | LOCATE(F)    | Individual output (Valid only when the component code is A3.)     | OFF ON                    | "H" when in standby mode.         |
| 26      | PC1    | Output | LOCATE(F)    | Individual output (Valid only when the component code is A3.)     | OFF ON                    |                                   |
| 27      | PC2    | Output | SPEED        | Individual output (Valid only when the component code is A3.)     | OFF ON                    |                                   |
| 28      | PC3    | Output | SIZE         | Individual output (Valid only when the component code is A3.)     | OFF ON                    |                                   |

Fig. 4-14

## 4.2 CONTROL PANEL EXPLANATION

### ● KEY SW (Control Switches)

The control panel of this player is as shown in figure 4-15. It performs the following functions:

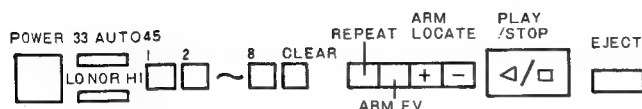


Fig. 4-15 KEY location

### 4.2.1 Power SW (Power Switch)

This switch turns on the power, resets the player, and returns the tonearm to the rest. (When the slide base is opened, the unit resets and returns the arm to the rest.)

- The UP light is on All others are off.
- The phono motor is stationary.

### 4.2.2 Speed SW (Speed Selector)

Sliding the speed selector to either 33 or 45 sets the phono motor rpms to 33 or 45 respectively. If the slide base is closed with this switch in the AUTO position, and then the unit is set to fully automatic or program selection mode, the player will select the motor speed automatically, based on the size of the record.

Record sized:

|       |            |
|-------|------------|
| 30 cm | 33 1/3 rpm |
| 25 cm | 33 1/3 rpm |
| 17 cm | 45 rpm     |

If you use the locate switch to play records manually (without using the automatic or program selection functions), the turntable will play all records at 33 1/3 rpm while the speed selector is in the AUTO position. If the slide base is opened after the size has been set, the rpm setting will be reset to 33 1/3 rpm. (If the speed selector is set to 33 or 45, however, the rpm setting will not change even when the slide base is closed.)

### 4.2.3 1 – 8 SW (Program Selection Switches)

- These are pressed for program selection.
- Selection repeat (up to 8 times) and programming (up to 15 steps) are possible).
- Pressing any of the buttons 1 through 8 will cause the tonearm to begin to search. It will move from the rest to the end of the record. When it has finished, the LED display will begin to blink, and the tonearm will proceed to the first selection on the program. However, if the tonearm has already searched after the slide base is closed, then the LED display will start blink-

ing without an additional search taking place. It will proceed directly to the first selection on the program. (If the slide base is opened, however, that search data will be cleared.)

- It is possible to add more selections to the program at any time. (Regardless of whether the tonearm is leading-in tracing or searching.) Moreover, when the selections have finished, or when the tonearm is returned with the S/S switch or the CLR switch, it is possible to reprogram selections even with the slide base out. The tonearm will return to the rest. And if the slide base is in position, the unit will begin to lead in or search.
- Reprogramming is not possible during fully automatic selection playing.

### 4.2.4 CLR SW (Clear Switch)

- Pressing this button clears all previously programmed selections.
- It can be used at any time. Like the S/S switch, the CLR switch interrupts the program that is being played. (The tonearm will return to the rest.

### 4.2.5 REP SW (Repeat Switch)

- This switch is used to repeat (or stop repeating) a selection.
- A selection may be repeated up to a maximum of 8 times. (During both program selection and fully automatic selection playing.) The LED display will start blinking when the weight repeat has been programmed.
- It can be used at any time. (It turns ON or OFF with each press of the button.) When the unit receives a "REP ON" command after it has finished playing a selection, or when the tonearm is returning after pressing the S/S switch, it will interpret this to mean that it should repeat starting with the next selection. When the "REP ON" command is made (except when the tonearm is on the rest) the player will first finish playing the entire side (when on automatic) or complete the entire program (when on program), return to the rest, and then lead in again.

### 4.2.6 EV SW (Cueing Switch)

- This switch raises and lowers the tonearm.
- The cueing switch will respond when the tonearm is all the way UP or tracing (all the way down, or moving down). When it is all the way up, it will respond to a down command, and when it is tracing, or moving down, it will respond to an up command. It won't respond to commands at any other time.

### 4.2.7 P/S SW (PLAY/STOP Switch)

- This switch is used to begin automatic playing and to end automatic or programmed playing.
  - It can be used at any time.
- When the slide base is open:  
If the tonearm is on the rest, automatic playing will begin.
- When the slide base is closed:  
When the tonearm is not on the rest, playing will stop and any repeat commands will be cleared.  
The tonearm will then return to the rest.  
All programming and repeat commands will be cleared.

### 4.2.8 < , > SW

- This switch has two separate functions
1. Function 1 . . . Locate.  
During automatic playing (when the tonearm is on the rest and the player is started using the S/S SW) and during manual playing (when the tonearm is on the rest and the player is started using the SW), this switch performs a locate function.  
<SW ON . . . The tonearm will move toward the center of the record.  
>SW ON . . . The tonearm will move toward the outside edge of the record.
  2. Function 2 . . . Skip  
During programmed playing (when the player is started using the program SW), this switch performs a skip function.  
<SW (+SKIP) . . . Player stops playing present selection and goes on to the next. It will skip one selection for each time it is pushed.  
>SW (-SKIP) . . . When pressed once it will return to the beginning of the present selection. If pressed N times, then it will go back N - 1 selections.

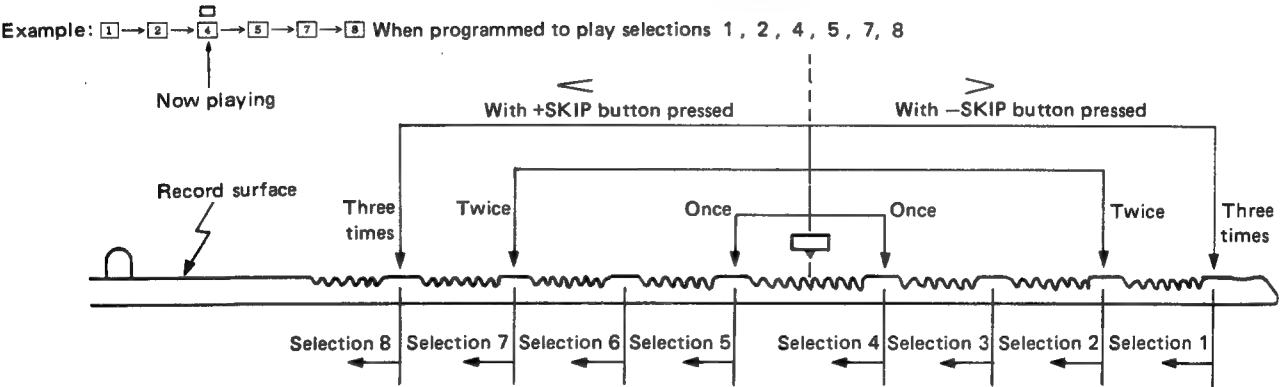


Fig. 4-16

## 4.3 MODE TRANSITION

### 4.3.1 Initial Reset

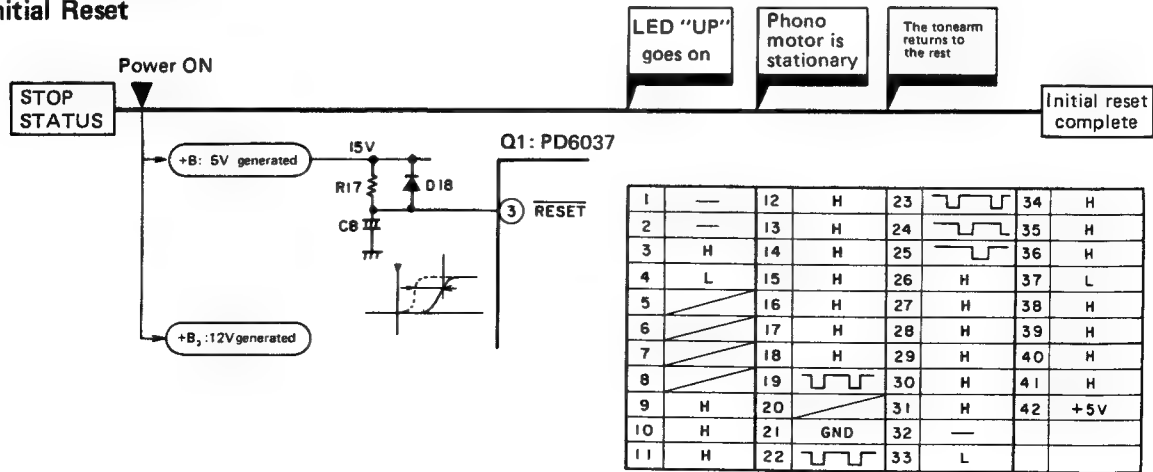
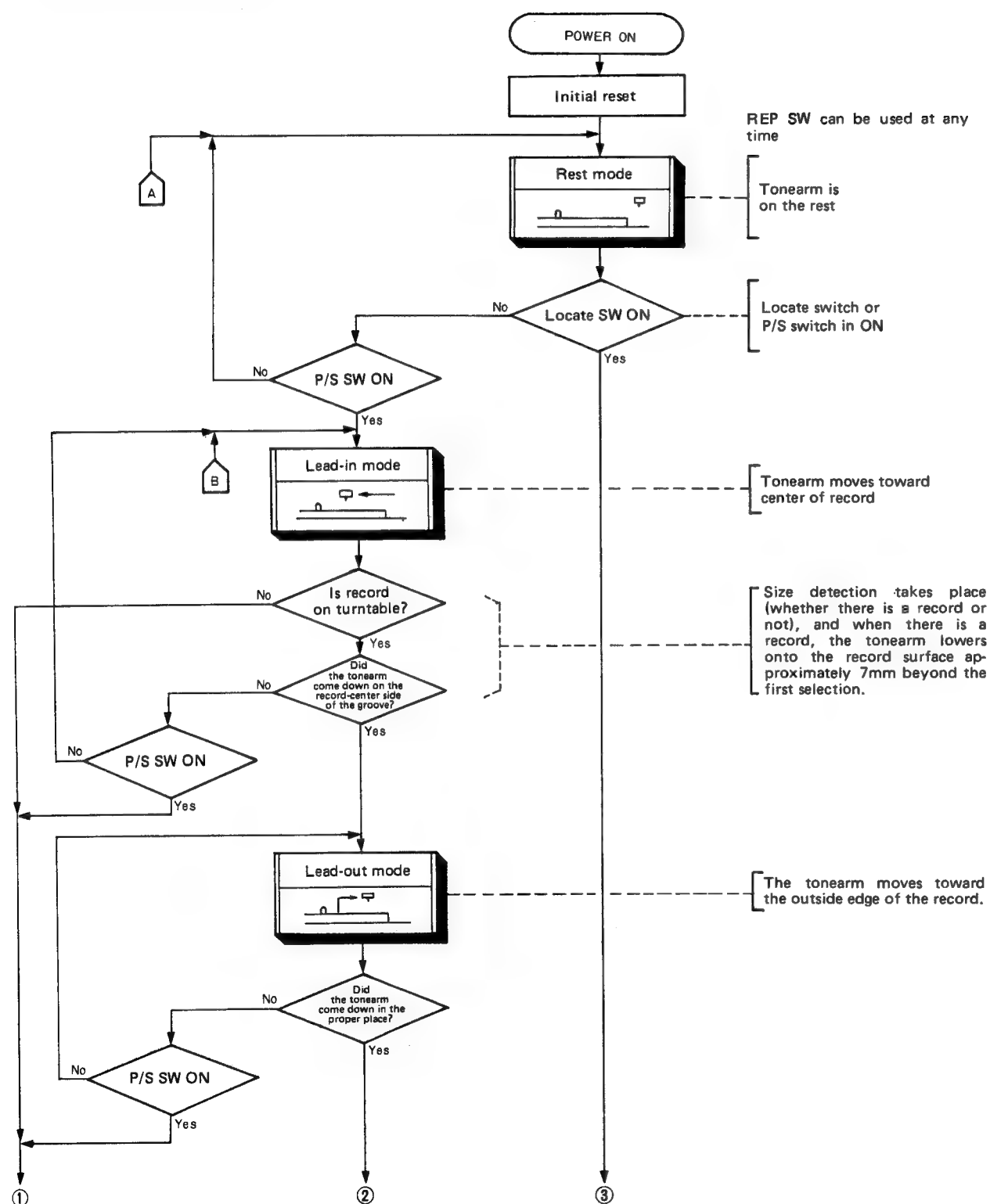


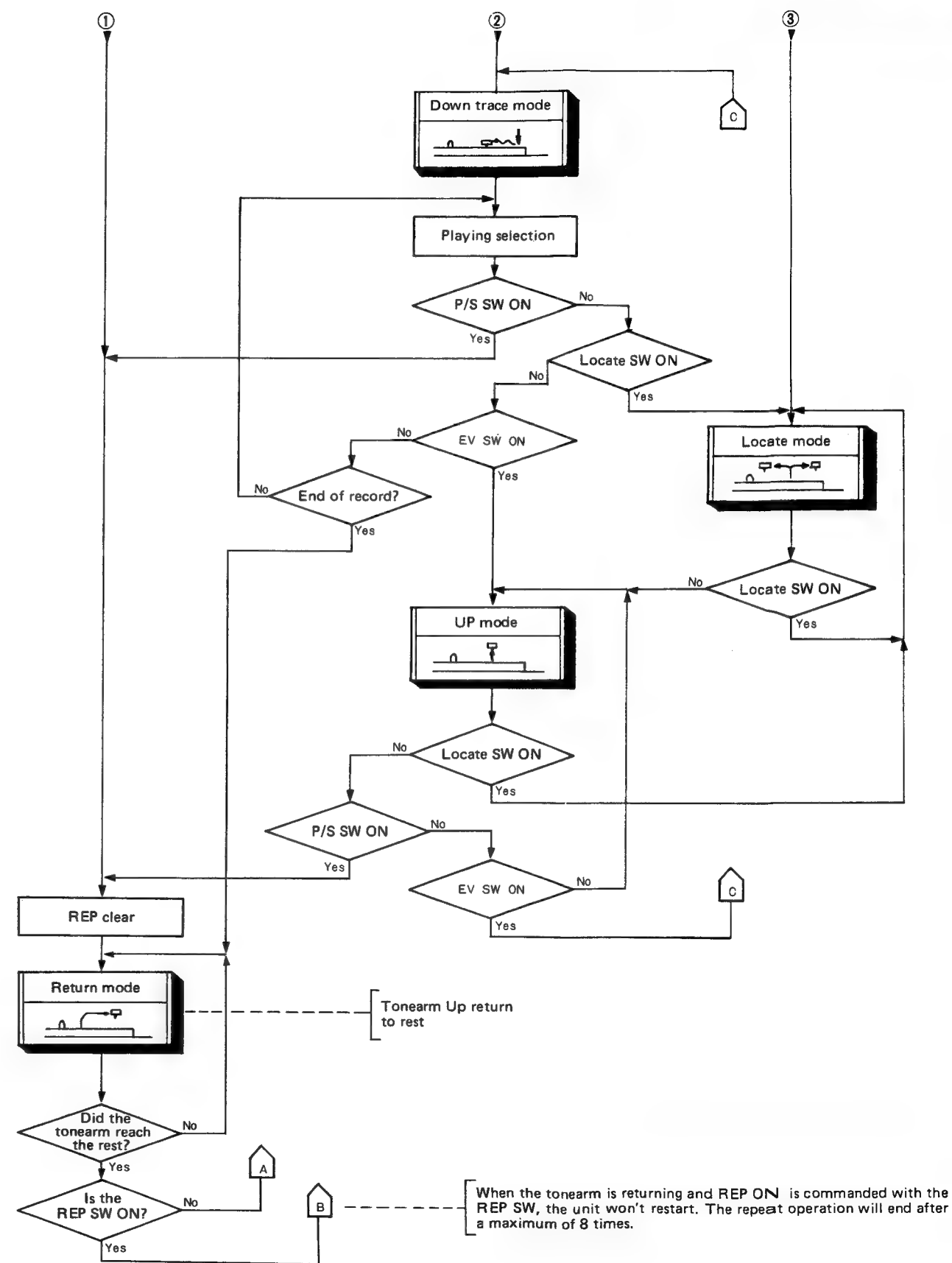
Fig. 4-17

#### 4.3.2 Mode Transition Chart 1

- When using automatic playing (no standby input)

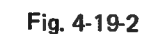


**Fig. 4-18-1**



**Fig. 4-18-2**

- **Using programmed playing (no standby input)**



## 4.4 OPERATION MODE EXPLANATIONS

### 4.4.1 Power ON

When the power is turned on or the cover is opened, the PL-V70 performs the following operations.

1. It returns the tonearm to the rest.
2. It turns off the program display (1 through 8) and the REP display LEDs and turns on the UP display LED.
3. It stops the phono motor rotation.
4. It turns the muting on.

Note:

In case of PL-V70, the UP LED blinks while the arm is moving.

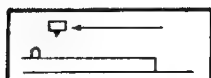
### 4.4.2 Rest Mode



With the PL-V70 on and awaiting input, all of the functions work with the exception of the EV SW. During the rest mode, the buttons, when pushed, perform the following functions.

1. SWs 1 through 8  
Pushing any of these will start the search mode. When searching has already been completed the lead-in mode will begin.
2. REP SW  
This turns the repeat function ON and OFF alternately.
3. < SW  
This turns the turntable and moves the tonearm toward the record center. With manual playing, it works as a locate SW.
4. P/S SW  
This starts the lead-in operation during automatic playing. (The turntable rotates and player switches to lead-in mode)

### 4.4.3 Search Mode



It does the following while moving the tonearm from the rest to the center of the record.

1. It determines the size of the record. (And the speed as well)
2. It records the band address.
3. It detects programmed selection.

When the speed SW is set to AUTO, the speed for 30cm and 25cm records is 33rpm. When the search mode detects a 17cm record, then it sets the speed to 45rpm. However, at this point, the turntable is not yet spinning.

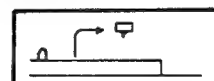
When the tonearm gets to the 17cm size area and detects no record, it then clears the program and repeat(s) (if any) and returns to the rest. (Switches to return mode.)

When the tonearm comes to the end of a record and it has programmed selection number that is higher than the actual number of record selections, it clears those numbers from its memory and begins the lead-out operation. (Switches to lead-out mode) For example, if the number of actual selections are programmed, then the numbers above 6 are cleared from the memory.

In the search mode, all functions work with the exception of EV, <, > SWs.

1. SWs 1 through 8  
Repeat input is possible, and up to 15 steps can be programmed into the PL-V70.
2. CLR SW  
It clears everything in the memory and the search operation will continue.
3. REP SW  
It turns the repeat ON and OFF alternately.
4. P/S SW  
It clears programmed selections and/or repeats and starts the return operation. (Switches to return mode.)

### 4.4.4 Lead-Out Mode



#### • During automatic playing

This moves the tonearm toward the outside edge of the record until it addresses the first selection.

Then it stops moving the tonearm, and starts to move it DOWN. (Switches to down trace mode.)

• **During programmed selection playing**

If the EV is DOWN, then it brings the tonearm UP and moves it toward the outside edge of the record. However, depending on whether it is pushed during the first selection of a program or after that, the operations change.

1. When pushed during the first selection of a program. It moves the tonearm to the address of the first selection, and thereafter operates as with automatic selection playing.
2. When pushed during subsequent selections of a program. It moves the tonearm back 64 address units from the selection address (approximately 7.3mm toward the outside edge of the record) where it changes direction and begins the lead-in operation. (Switches to lead-in mode.)

In the lead-out mode the REP and S/S SWs work, but the other functions, program SWs (1 through 8) and the CLR only work during programmed selection playing.

1. **REP** SW

This turns the repeat ON and OFF alternately.

2. **P/S** SW

This clears any programming and/or repeat(s) and starts the retung operation. (Switches to the return mode.)

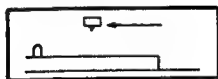
3. SWs **1** through **8**

These permit repeating the same selection and the addition of more programming (up to 15 steps) during programmed selection playing.

4. **CLR** SW

This clears programming. After that, it switches to automatic playing. (It starts leading out to the first selection)

#### 4.4.5 Lead-In Mode



• **During fully automatic playing**


If the size of the record has not yet been determined, the tonearm does this while moving to the address of the first selection +64 address units, (approximately 7.3mm closer to the center of the record). These is changes direction and begins to lead out. (Switches to lead-out mode.)

• **During programmed selection playing**

This mode moves the tonearm toward the center of the record. Depending on whether the button is pushed during the first selection of a program or during subsequent selections, the operations change as follows.

1. When pushed during the first selection of a program. It moves the tonearm to the address of the first selection +64 address units (approximately 7.3mm toward the center of the record), changes direction, and starts to lead out. (Switches to lead-out mode.)

2. When pushed during subsequent selections of a program. It moves the tonearm toward the center of the record, to the programmed selection address -16 address units (approximately 1.8mm toward the outside edge of the record), where it begins detecting the band.

While moving the tonearm toward the center of the record it detects a trailing signal (  ) as shown in figure 4-20. The tonearm stops when it has detected the signal, and then lowers. (Switches to pre-down mode.)

When the tonearm doesn't detect a band even after going to the programmed selection address +16 address units (about 1.8mm closer to the center than the band) then it begins leading out. (Switches to lead-out mode.)

When the tonearm has not detected the selection band after repeating the lead-in/lead-out sequence 4 times it goes on to the next programmed selection.

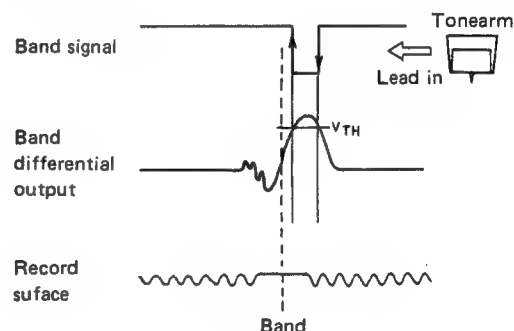


Fig. 4-20

In the lead in mode, as with the lead out mode, the REP and P/S switches work, but the other functions, program switches (1 through 8) and the CLR only work during programmed selection playing. The operations performed after the commands are received are the same as with the lead out mode.

#### 4.4.6 Pre-Down Mode



The pre-down mode is the mode which moves the tonearm down after the band has been detected by the lead-in mode (during programmed selection playing for all selections except the first). After the tonearm goes down, it traces the air with the muting ON until it finds the center of the band (zero cross).

Then the tonearm goes down, a landing sensor starts the tracking when the tonearm comes to rest on the record. When the zero cross input H is detected while tracking, the muting is turned off and normal tracing begins. (Switches to down trace mode.)

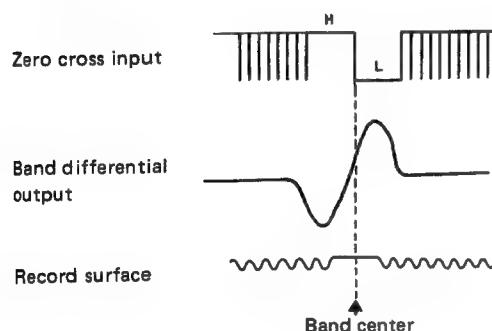
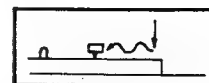


Fig. 4-21

In the pre-down mode all of the input SWs function.

1. SWs **1** through **8**  
Selection repeat is possible, and up to a maximum of 15 steps are programmable.
2. **CLR** switch
3. **REP** switch  
Turns the repeat function ON and OFF alternately.
4. **EV** switch  
Starts the UP operation. (Switches to UP mode.)
5. **< , >** SW  
Starts the +SKIP and -SKIP operations. (Switches to the lead out-mode.)
6. **P/S** SW  
Clears programmed repeat(s) and starts the return operation. (Switches to the return mode.)

#### 4.4.7 Down Trace Mode



##### ● With fully automatic playing

It turns off the UP LED and sets the tonearm down.

During the first second of lowering the tonearm, the elevation solenoid draws a current of 170mA. After that, it draws 70mA.

The leading sensor determines whether or not the tonearm is in contact with the record. When it senses that it is, it begins to watch for the end.

When it has detected the end, it checks the repeat LED, and if there are any repeats, it counts them and begins the return operation. (The maximum number of repeats is 8, and the repeat LED will begin blinking when the number of repeats reaches 8.) (It then switches to the return mode.)

##### ● With programmed selection play

As with fully automatic playing, the UP LED is turned off and the tonearm is lowered. When the landing sensor comes to rest on the record, it runs OFF the muting and turns ON the tracking. With the position of the tonearm within  $\phi 125\text{mm}$  the sensor watches for the end.

When switching to this mode from the pre-down mode, the muting is switched to OFF. (There are other changes.)

While tracing with the tracking on, this mode watches the tonearm position address and when it comes to the band at the end of the selection it is playing — 16 address units (approximately 1.8mm from that band toward the outside edge of the record) it starts the band sensor.

When it detects the middle of a band (at the end of the record it detects the end), it turns ON the muting, and lifts the tonearm up in order, to continue on to the next selection in the program. (Switches to lead-out mode.)

When all of the programmed selections have finished, this mode checks the number of repeats and then, if there are any, begins the repeat operation. (Switches to the return mode) (The maximum number of repeats is 8, and when the number of repeats reaches 8 the REP LED begins blinking.)

With down trace all of the functions work during programmed selection playing, and with automatic playing all functions work except the program switches and the clear SW.

1. **REP** SW

It turns the repeat function ON and OFF alternately.

2. **EV** SW

It starts the UP operation. (Switches to UP mode.)

3. **P/S** SW

It clears and programming and/or repeats and/or repeats and starts the return operation. (Switches to the return mode.)

4. **< , >** SW

• **With programmed selection playing.**

Starts the +SKIP —SKIP operations. (Switches to the lead-out mode.)

• **With fully automatic playing**

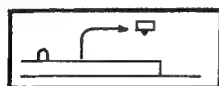
Starts the UP operation. (Switches to the UP mode.) The following function only operate with programmed selection playing.

5. **SWs 1 through 8**

Selection repeat and up to 15 steps of additional programming is possible.

6. **CLR** SW

#### 4.4.8 Return Mode



If the tonearm is DOWN (EV DOWN) then it lifts it UP, stops the turntable, and returns the tonearm to the rest.

If the repeat SW is ON, (Except when turned to during return) then at the same time that the tonearm returns to the rest, it will start the turntable rotating in order to play the next selection, and begin leading in the tonearm. (Switches momentarily to the lead-out mode and then to the lead-in mode.)

At times other than these, (i.e. turning the REP SW ON during return) the tonearm will be at the rest on standby unless there is a command to start from one of the program SWs or the P/S SW. (Switches to the rest mode.)

When the playing has finished, or has been terminated, program switches 1 through 8 still function while the tonearm returns to the rest. When the tonearm returns to the rest, and if the search operation has not yet been completed (i.e., the slide base was opened during tonearm return), then the search operation begins. (The unit enters the search mode.) If the search operation has already been completed, the lead-in operation

begins. (The unit enters the lead-in mode.) If the slide base is out, the tonearm remains on the rest until the slide base is closed.

In the return mode, the operable switches differ depending on whether it is a return that takes place during a repeated selection, or a return that takes place at the end or middle of a selection.

• **With a return during a repeated selection. (REP SW ON)**  
During automatic or programmed selection playing.)

1. **REP** SW

It runs the repeat function ON or OFF alternately.

(Cancels the repeat selection.)

2. **P/S** SW

This clears the programmed selection and/or repeats.

(Cancels the repeat selection.)

(This works with programmed selection playing, but not with fully automatic playing.)

3. **SWs 1 through 8**

Selection repeat and up to 15 steps of additional programming are possible.

4. **CLR** SW

This switch clears the stored program and the repeat mode, and returns the arm to the rest.

• **With a return at the end or middle of a selection**

1. **SWs 1 through 8**

Repeat input is possible, and up to 15 steps of new programming is possible.

2. **CLR** SW

This clears all programmed selections.

3. **REP** SW

This turns the repeat function ON and OFF alternately.

4. **P/S** SW

Clears all programmed selection and/or repeats.

#### 4.4.9 UP Mode



This mode lights the UP LED, turns ON the muting and raises UP the tonearm. When the EV chip and the EV bar make contact and the stylus leaves the surface of the record, the landing sensor detects this and turns OFF the tracking. Then, after about 1.1 seconds it detects that the tonearm has moved UP.

Function that will work when the tonearm is UP and when it is moving UP differ depending on whether the playing is fully automatic or programmed selection.

- During fully automatic playing

1. The **CLR** SW and **1** through **8** don't function.

2. **REP** SW

Turns the repeat function ON and OFF alternately.

3. **EV** SE

- When the tonearm is moving UP ..... no response.
- When the tonearm is UP ..... the down operation takes place. (Switches to down trace mode.)

4. **< , >** SW

- When the tonearm is moving UP ..... no response
- When the tonearm is UP ..... the locate operation begins. (Switches to locate mode.)

5. **P/S** SW

It clears the repeats and starts the return operation. (Switches to the return mode.)

- During programmed selection playing

1. SWs **1** through **8**

Selection repeat and up to 15 steps of additional programming are possible.

2. **CLR** SW

Clears all programmed selections, and then switches to fully automatic playing.

3. **REP** SW

Turns the repeat function ON and OFF alternately.

4. **EV** SW

- When the tonearm is moving UP ..... no response
- When the tonearm is UP ..... the down operation takes place. (Switches to down tape mode.)

5. **< , >** SW

- When the tonearm is moving UP ..... it begins  $\pm$  SKIP operations. (Switches to the lead-out mode.)
- When the tonearm is UP ..... no response.

6. **P/S** SW

Clears all programmed selections and/or repeats and begins the return operation. (Switches to return mode.)

#### 4.4.10 Locate Mode



The locate mode is a passing mode that works during programmed selection playing when the SW or the **<** SW is pushed and held.

When the **<** SW is ON,

The tonearm moves toward the center of the record. (up to approximately  $\phi 106\text{mm}$ )

When the **>** SW is ON,

The tonearm moves toward the outside edge of the record. (up to the rest)

When the **</>** SW is OFF, the tonearms stops, and goes into the UP position. (Switches to the UP mode.)

• Do not push 2 buttons at the same time with the PL-V70, regardless of the modes. None of the input will be accepted when two function buttons are pushed at the same time. (However, it is possible to change the 33/45 speed while performing another function.)

Modes and the corresponding operable functions

Prog . . . Programmed selection playing  
Full . . . Automatic playing

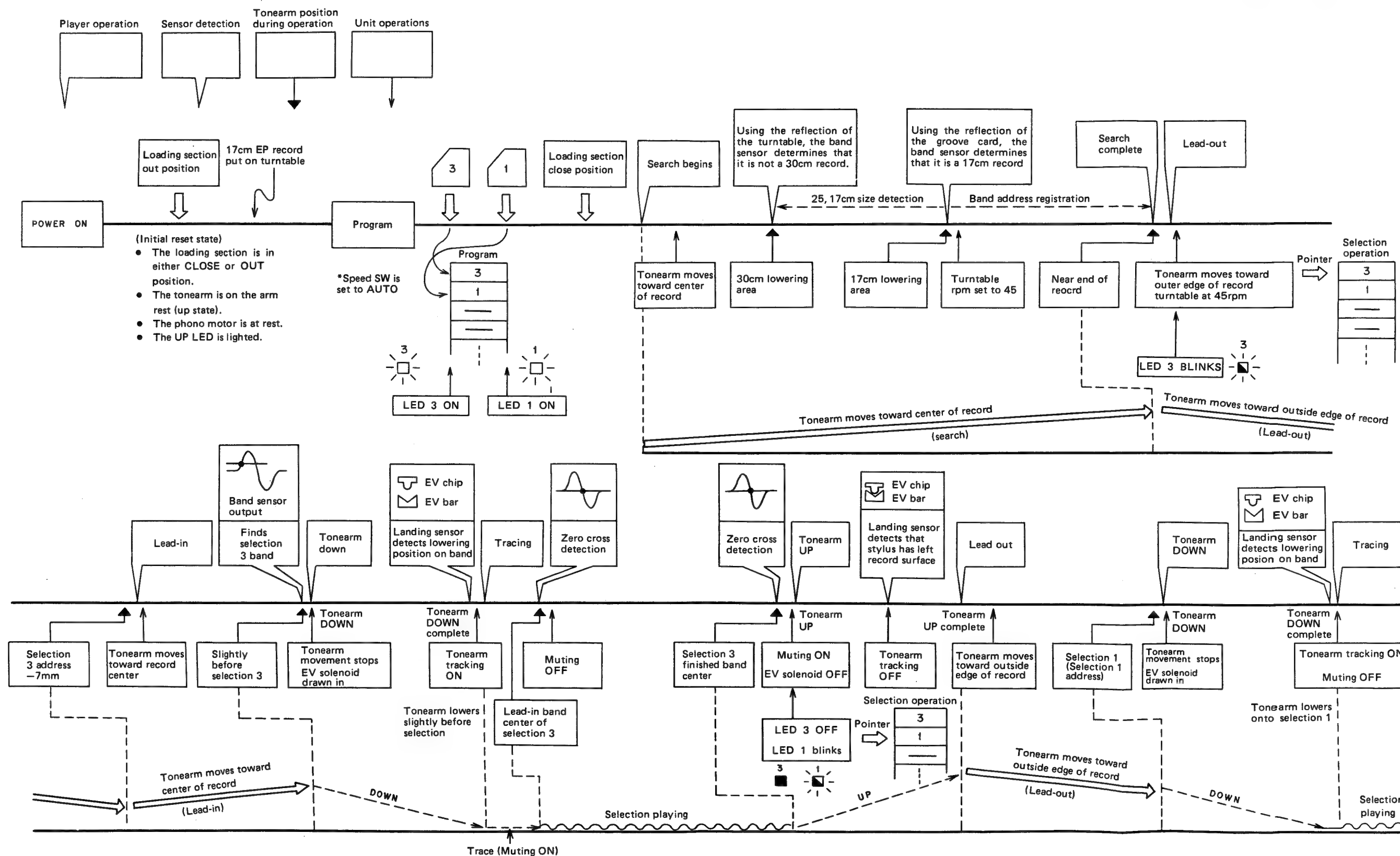
| Switch name<br>Mode                    | Program 1 through 8       |                             | Clear CLR | Repeat REP | Tonearm<br>elevation EV | Play/Stop P/S | Locate/skip<br>+SKIP -SKIP<br>< > |              |
|----------------------------------------|---------------------------|-----------------------------|-----------|------------|-------------------------|---------------|-----------------------------------|--------------|
| Rest mode                              | Search system<br>(Search) | Search system<br>(Lead-out) | X         | ○          | X                       | (Lead-out)    | (Locate)                          |              |
| Search mode                            | ○                         |                             | ○         | ○          | X                       | (Return)      | X                                 |              |
| Lead-out mode                          | Prog<br>○                 | Full<br>X                   | ○         | ○          | X                       | (Return)      | X                                 |              |
| Lead-in mode                           | ○                         | X                           | ○         | ○          | X                       | (Return)      | X                                 |              |
| Pre-down mode                          | ○                         | /                           | ○         | ○          | (UP)                    | (Return)      | (Lead-out)                        |              |
| Down trace mode                        | ○                         |                             | ○         | ○          | (UP)                    | (Return)      | Prog<br>(Lead-out)                | Full<br>(UP) |
| Return mode                            | ○                         | X                           | ○         | ○          | X                       | (Return)      | X                                 |              |
| UP mode                                | ○                         | X                           | ○         | ○          | (Down trace)            | (Return)      | X                                 | (Locate)     |
| Locate mode                            | —                         |                             | —         | —          | —                       | —             | —                                 |              |
| ( Slide base<br>lead-out<br>completed) | ○                         |                             | ○         | ○          | X                       | *○            | X                                 |              |

(— Do not push two function buttons at the same time.)  
(\* Clears 1 through 8)  
(○ = Yes, X = No)

Fig. 4-22

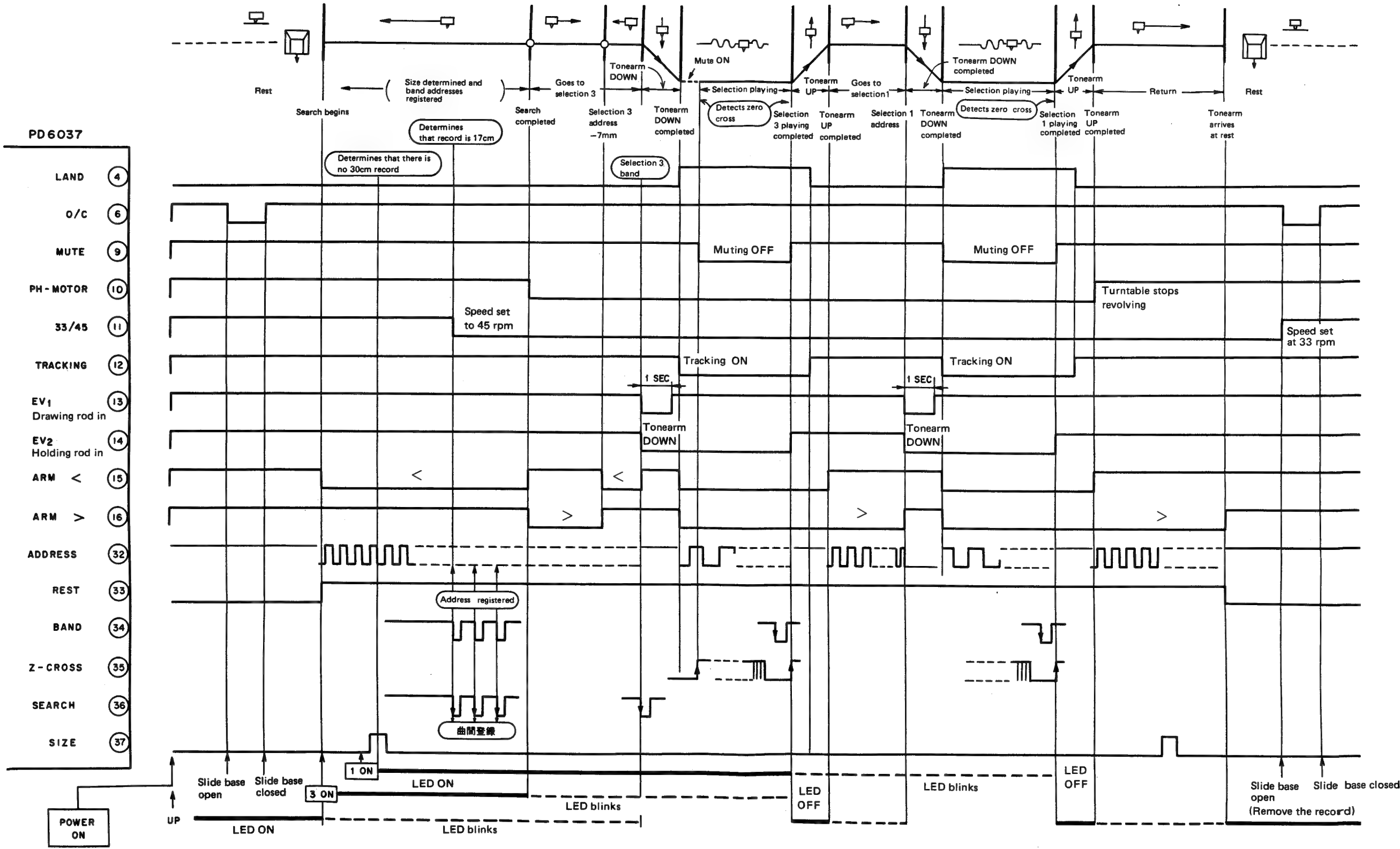
## 4.5 OPERATION CHART

17 cm EP record Programmed to go from selection 3 to selection 1





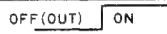

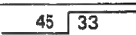
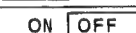
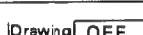

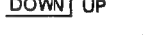
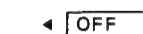

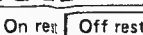




4.6 TIMING CHART

17cm EP record a single cycle of operations performed in going from selection 3 to selection 1  
With SPEED SW set to AUTO No. F. STNBY input



## 4.7 IC INFORMATION

## ● PD6037

| Pin No. | Symbol | Terminal name        | I/O | Function                                                                                                                                                  |
|---------|--------|----------------------|-----|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | Extal  | —                    | —   | Terminal with a built-in clock oscillator to connect with outside circuits<br>(Ceramic oscillator f=3MHz)                                                 |
| 2       | Xtal   | —                    | —   |                                                                                                                                                           |
| 3       | RESET  | —                    | I   | CPU initial reset input (normally H)                                   |
| 4       | IRQ    | LAND                 | I   | Tonearm down complete detection input                                  |
| 5       | SO     | Not in use           | —   |                                                                                                                                                           |
| 6       | SI     | O/C                  | I   | Slide base in/out detection switch input                                                                                                                  |
| 7       | SC/TO  | Not in use           | —   |                                                                                                                                                           |
| 8       | TC     | Not in use           | —   |                                                                                                                                                           |
| 9       | P0     | MUTE                 | O   | Muting ON/OFF (Deck synchronizer output)                               |
| 10      | P1     | PH-MOTOR             | O   | Phono motor start/stop output                                          |
| 11      | P2     | 33/45                | O   | Phono motor 33/45 switch output                                        |
| 12      | P3     | TRAKING              | O   | Tonearm tracking during tracing                                        |
| 13      | O1     | EV1 (drawing rod in) | O   | Tonearm elevation drive output (drawing rod in) drawing time 1 second  |
| 14      | O1     | EV2 (holding rod in) | O   | Tonearm elevation drive output (holding rod in)                        |
| 15      | O2     | ARM <                | O   | Tonearm motor drive output (movement toward center of record)         |
| 16      | O3     | ARM >                | O   | Tonearm motor drive output (movement toward outside edge of record)  |
| 17      | O4     | LED                  | O   | LED matrix output                                                                                                                                         |
| 18      | O5     | LED                  | O   | LED matrix output                                                                                                                                         |
| 19      | O6     | LED                  | O   | LED matrix output                                                                                                                                         |
| 20      | O7     | Not in use           | —   |                                                                                                                                                           |
| 21      | VSS    | —                    | —   | GND                                                                                                                                                       |
| 22      | R0     | Digit                | O   | KEY LED matrix output                                                                                                                                     |
| 23      | R1     | Digit                | O   | KEY LED matrix output                                                                                                                                     |
| 24      | R2     | Digit                | O   | KEY LED matrix output                                                                                                                                     |
| 25      | R3     | Digit                | O   | KEY LED matrix output                                                                                                                                     |
| 26      | R4     | Key in               | I   | KEY matrix input                                                                                                                                          |
| 27      | R5     | Key in               | I   | KEY matrix input                                                                                                                                          |
| 28      | R6     | Key in               | I   | KEY matrix input                                                                                                                                          |
| 29      | R7     | Key in               | I   | KEY matrix input                                                                                                                                          |
| 30      | R8     | 45rpm                | I   | 33/45 speed switch 45 input                                                                                                                               |
| 31      | R9     | 33rpm                | I   | 33/45 speed switch 33 input                                                                                                                               |
| 32      | R10    | Address              | I   | Address sensor input                                                 |
| 33      | R11    | REST                 | I   | Rest switch input                                                    |
| 34      | R12    | BAND                 | I   | Band sensor band input                                               |
| 35      | R13    | Z-Cross              | I   | Band sensor zero cross input                                         |
| 36      | R14    | Search               | I   | Band sensor search input                                             |
| 37      | R15    | SIZE                 | I   | 30cm record size detection input                                     |
| 38      | K0     | REM IN L1            | I   |                                                                                                                                                           |
| 39      | K1     | REM IN L0            | I   |                                                                                                                                                           |
| 40      | K2     | REM IN L2            | I   |                                                                                                                                                           |
| 41      | K3     | REM IN L3            | I   |                                                                                                                                                           |
| 42      | Vcc    | —                    | —   | +5V                                                                                                                                                       |

5. DISASSEMBLY

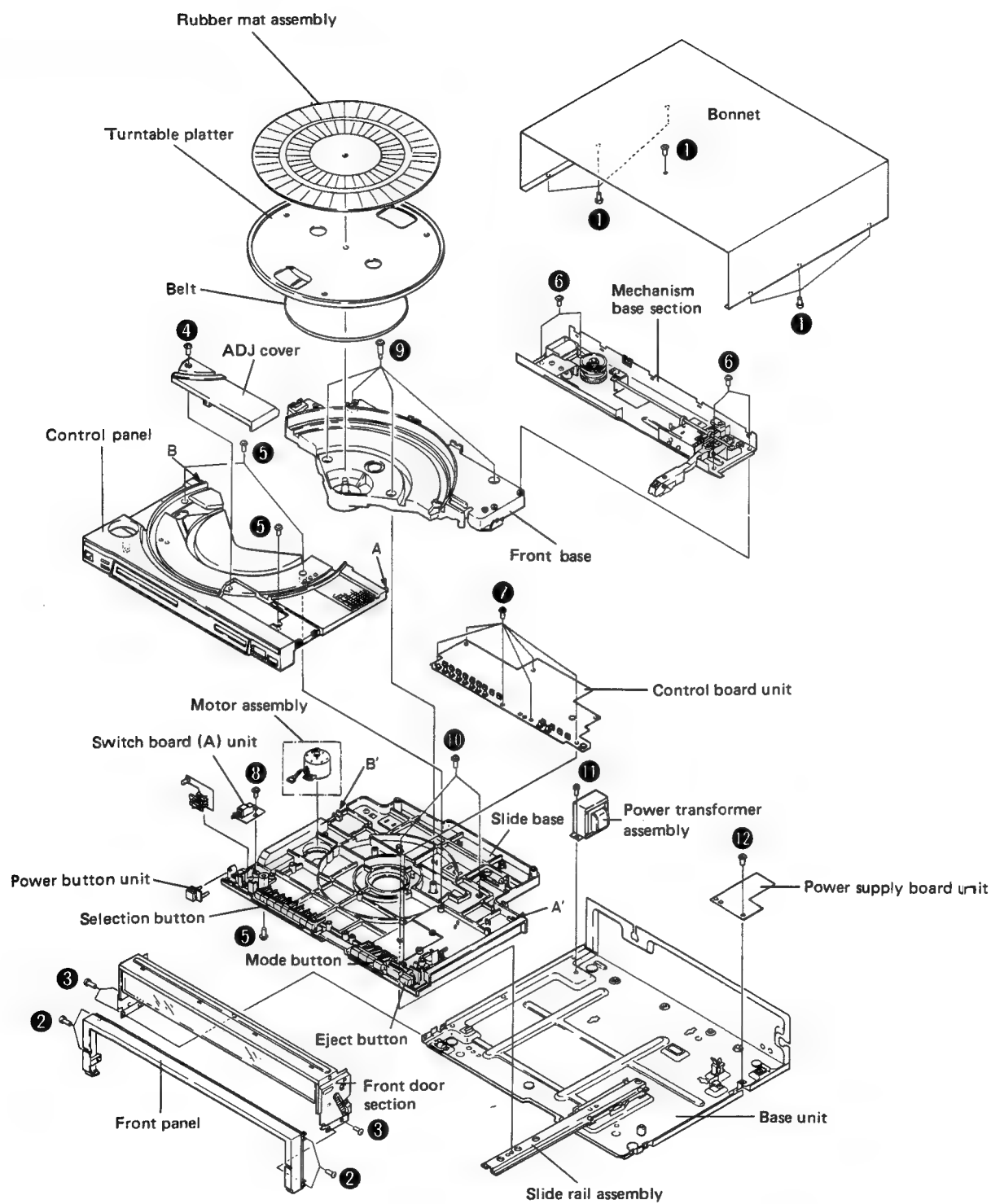


Fig. 5-1 Disassembly

## 5.1 DISASSEMBLY

1. Press the eject button and move the control panel to the position where the record can be removed. Remove the turntable mat assembly, turntable platter, and belt, and move the operation panel back to the PLAY position.
2. Removing screw ① releases the bonnet.
3. Removing screw ② releases the front panel.
4. Removing screw ③ releases the front door unit.
5. To remove the control panel, first remove screw ④ and then the ADJ cover. Then press the eject button to move the control panel out to the OUT position. Remove screw ⑤ and gently pull the control panel away from the unit. Note that the control panel can be removed with the bonnet in place.

When attaching the control panel, place the protruding parts A and B of the control panel in the holes A' and B' of the slide base, and push them in.

6. Removing screw ⑥ releases the mechanism base section.
7. Remove the program selection button, the mode button, and screw ⑦. The control board unit can now be removed.
8. Removing screw ⑧ releases the switch board (A) unit.
9. Removing screw ⑨ releases the front base.
10. Removing screw ⑩ releases the slide base from the slide rail assembly.

11. Removing screw ⑪ releases the power transformer assembly.
12. Removing screw ⑫ releases the power supply board unit.

## 5.2 CARRIAGE REMOVAL

1. Remove the fixer from the carriage and the wire from the pulley. (See Figure 5-2)
2. Remove the screw ⑬ and pull the guide bar away from the carriage in the direction indicated by the arrow. The carriage and tonearm assembly can now be removed.
3. Removing the spring will release the carriage board assembly, and removing screw ⑭ will release the mechanism base board assembly.

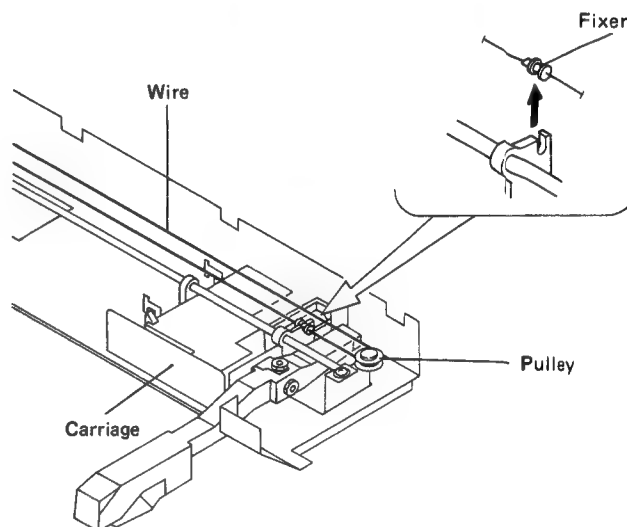


Fig. 5-3 Removing Carriage Wire

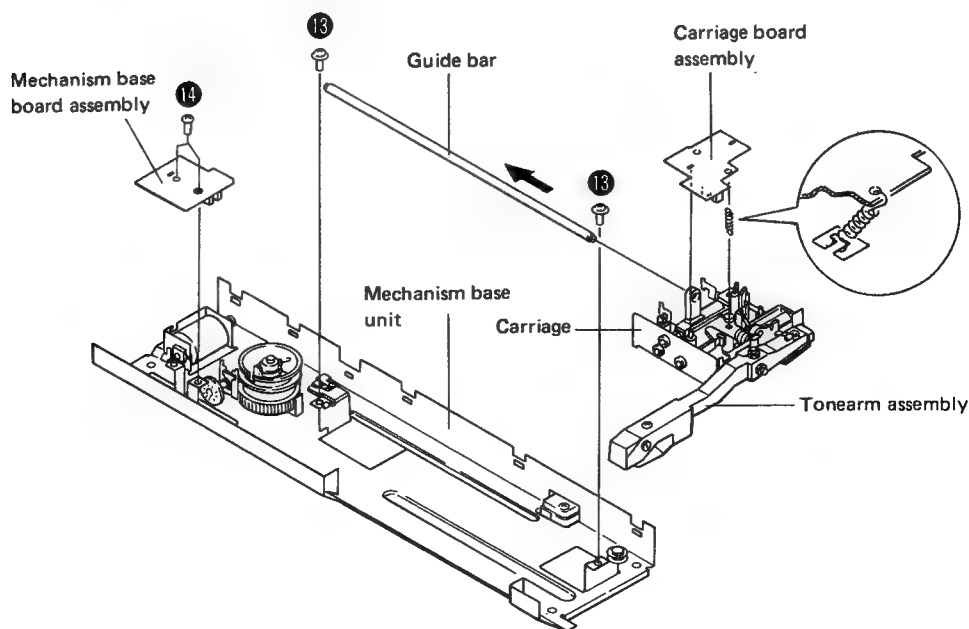


Fig. 5-2 Carriage Removal

### 5.3 REPLACING THE CARRIAGE WIRE

- After assembling the carriage and tonearm assemblies in the opposite order of the previous section, replace the carriage wire according to the following steps.

1. Adjust the length of the wire unit as shown in figure 5-4 (A).
2. Attach the wire unit grommet to the spring of the worm wheel as shown in figure 5-4 (B). Then wind the wire onto the worm wheel taking care not to let it get caught in the worm wheel groove. Also be careful not to let the wire overlap.

3. Holding both the wire and the worm wheel, connect the wire to the wire guard and attach the worm wheel to the mechanism base.
4. As shown in figure 5-4 (C), put the wire around the pulley, and push the fixer into the carriage until it locks with a click.

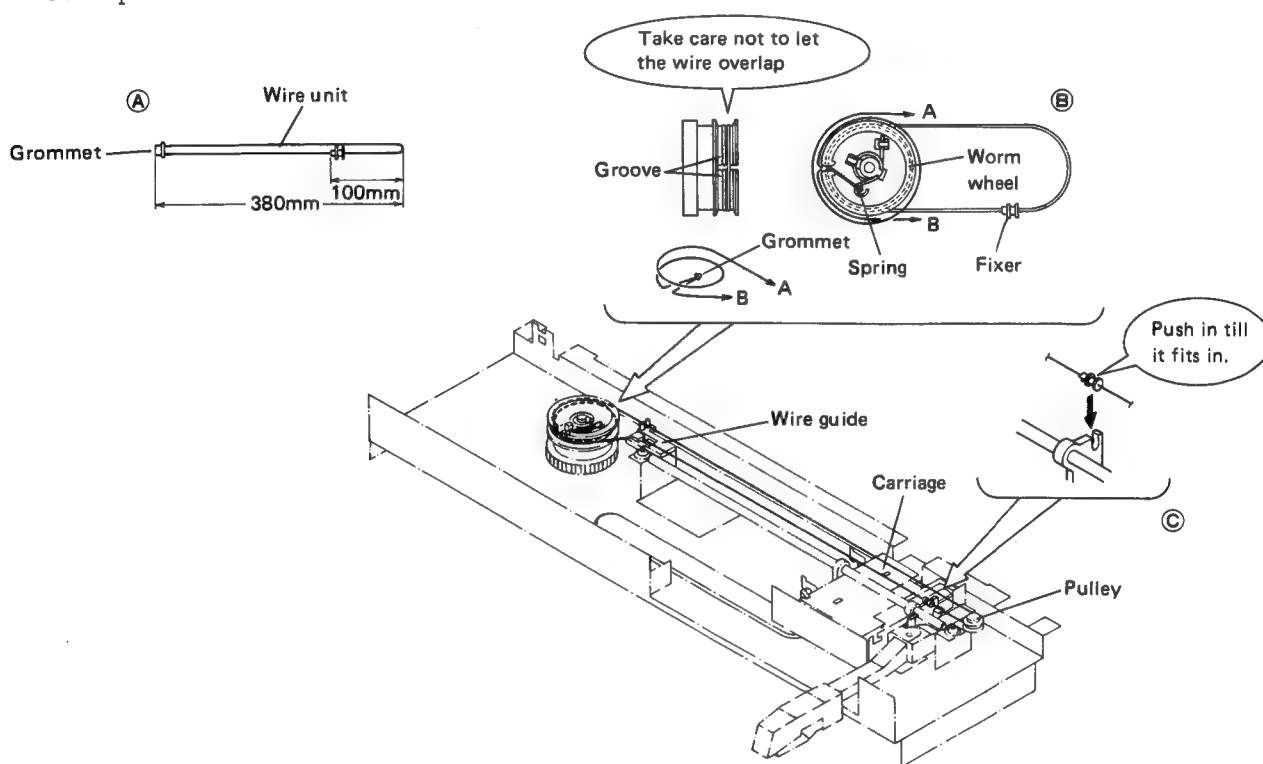


Fig. 5-4 Wire Replacement

### 5.4 LEAD LINE DISPOSAL

1. Move the carriage to the extreme right of the slidable range.
2. Fix the length of lead line ● at the hole (indicated by an arrow) under the projecting metal piece.
3. Move the carriage to the left and right, and check to make sure that the lead lines don't hit the carriage.

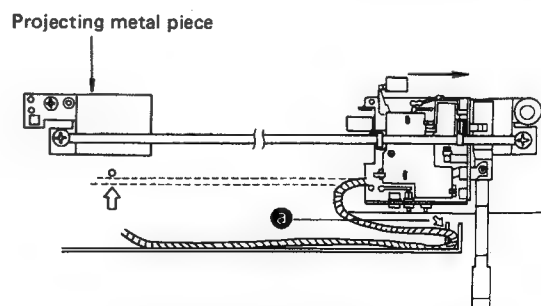



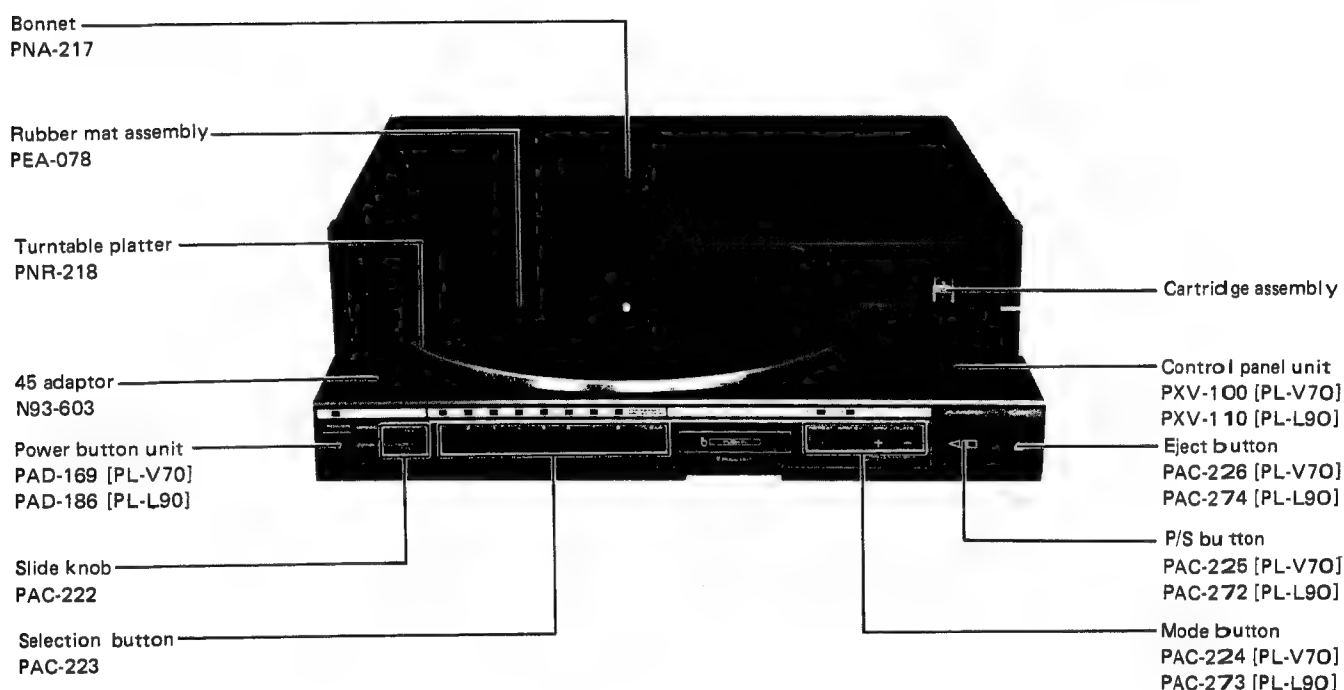
Fig. 5-5 Lead Line Disposal

## 6. PARTS LOCATIONS

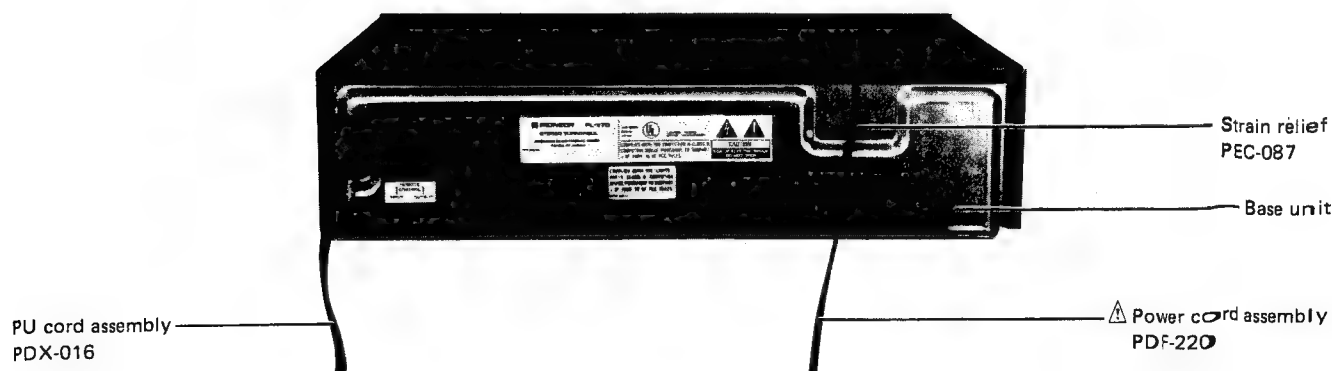
### NOTES:

- The  mark found on some component parts indicates the importance of the safety factor of the part. Therefore, when replacing, be sure to use parts of identical designation.
- For your Parts Stock Control, the fast moving items are indicated with the marks **★★** and **★**.  
**★★ GENERALLY MOVES FASTER THAN ★**  
 This classification shall be adjusted by each distributor because it depends on model number, temperature, humidity, etc.

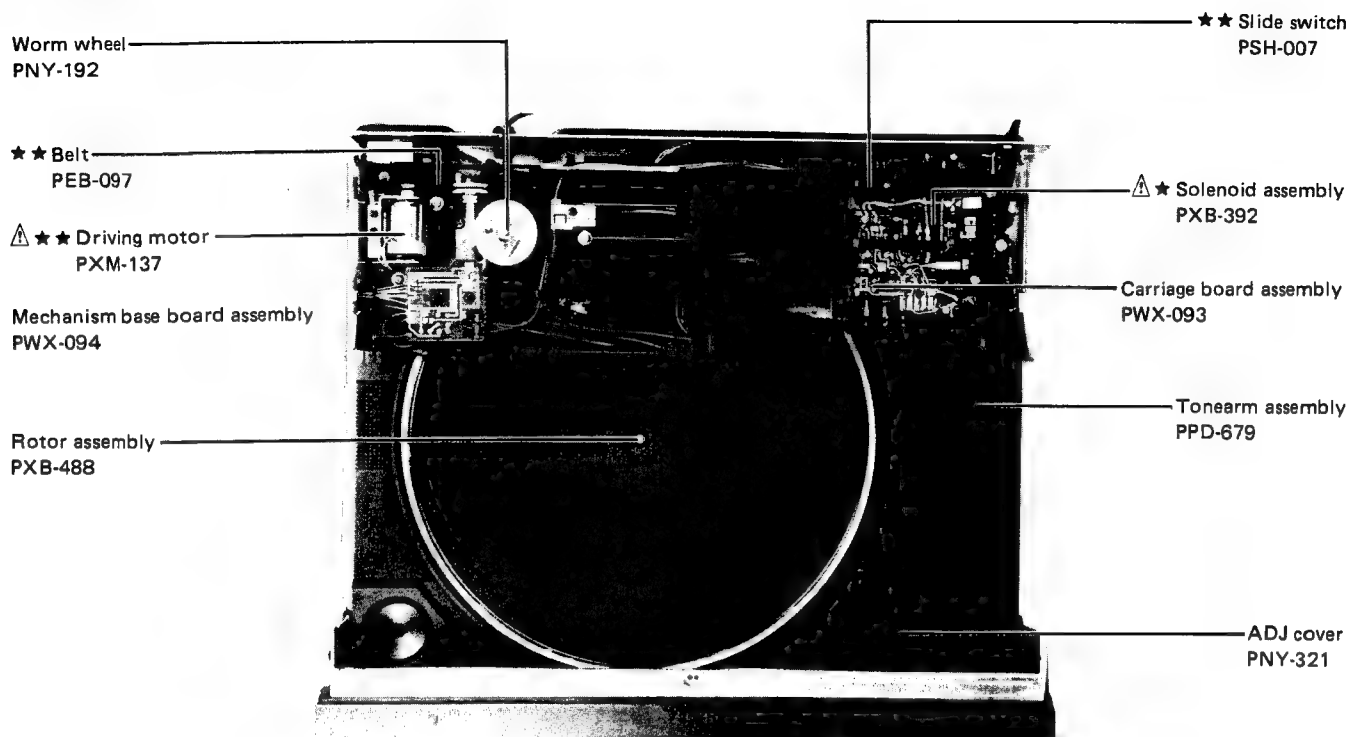
### Front Panel View



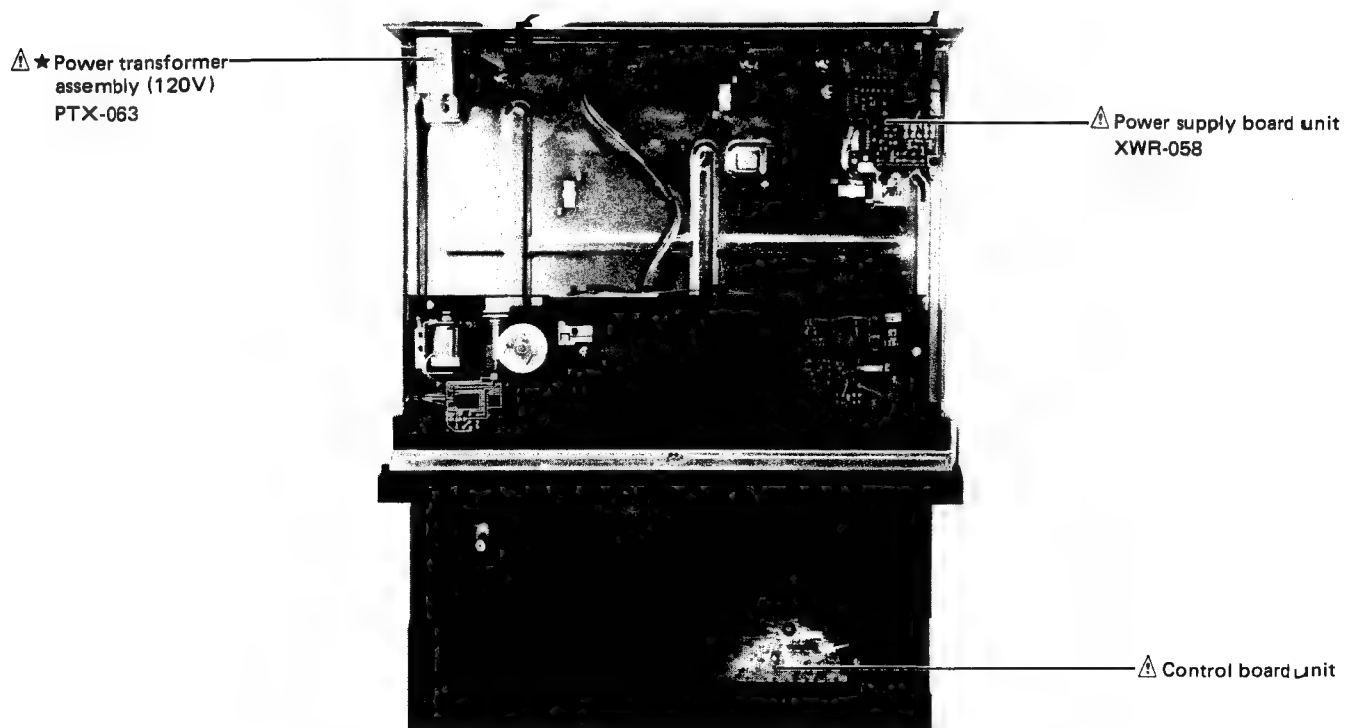
### Rear Panel View



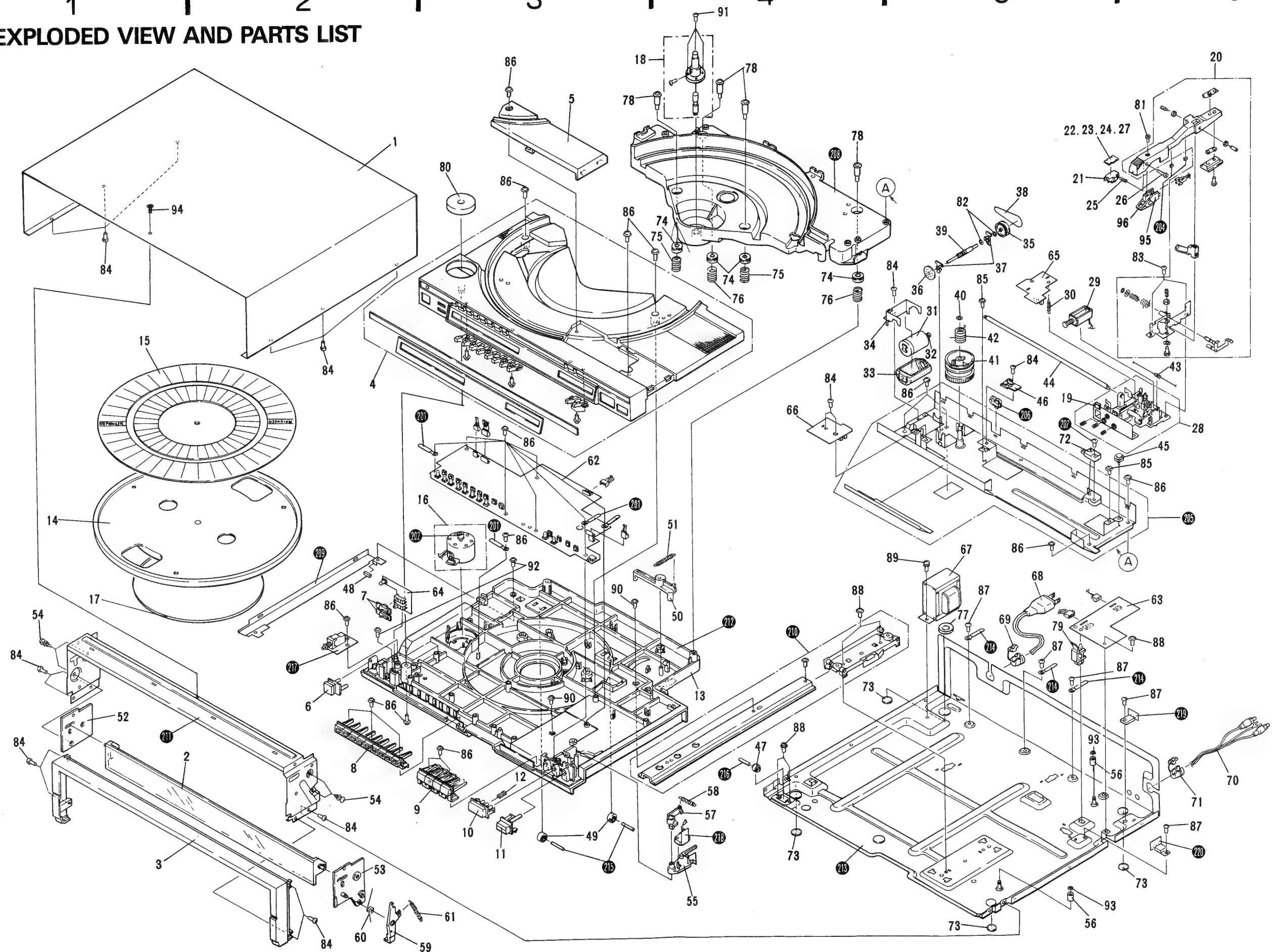
## Top View 1



## Top View 2



# 7. EXPLODED VIEW AND PARTS LIST



Parts  
Mark

NOTES:

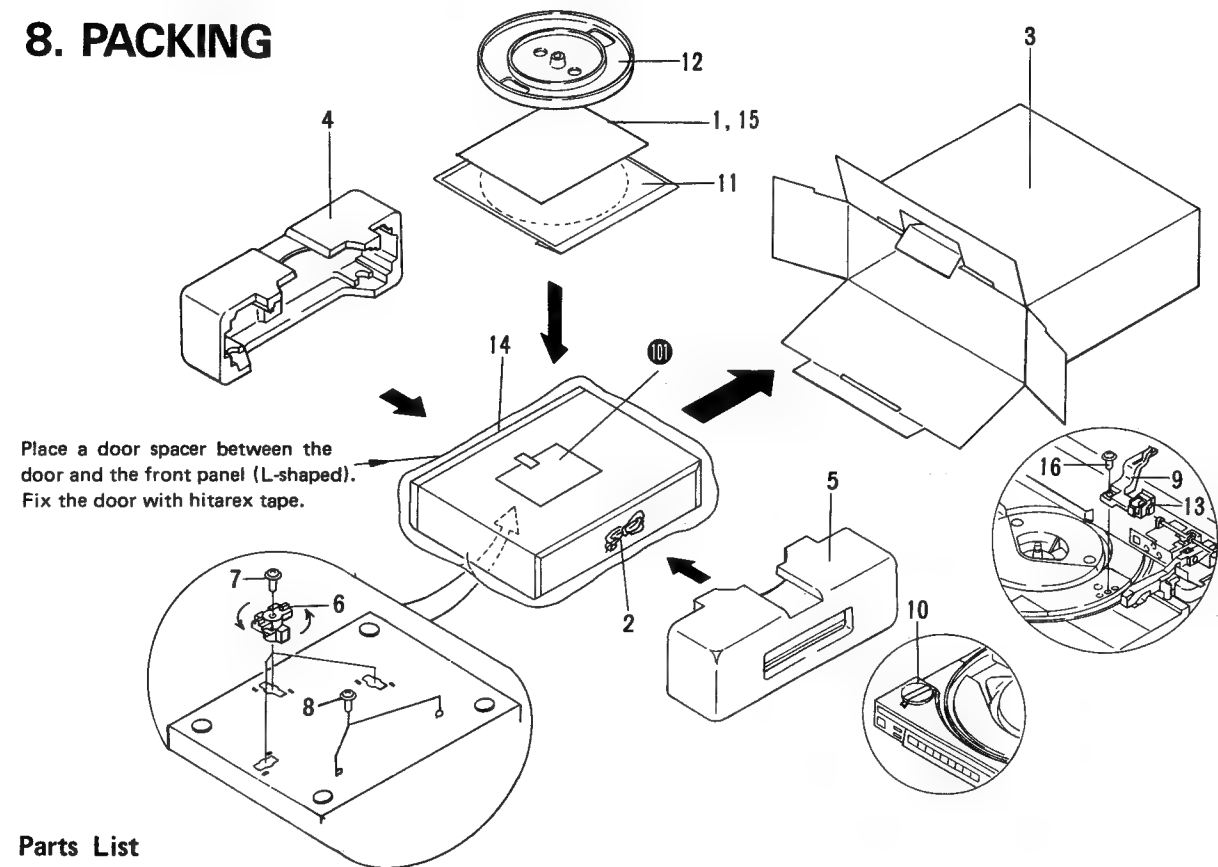
- Parts without part number cannot be supplied.
- The  $\Delta$  mark found on some component parts indicates the importance of the safety factor of the part. Therefore, when replacing, be sure to use parts of identical designation.
- For your Parts Stock Control, the fast moving items are indicated with the marks  $\star\star$  and  $\star$ .  
 $\star\star$  GENERALLY MOVES FASTER THAN  $\star$   
This classification shall be adjusted by each distributor because it depends on model number, temperature, humidity, etc.

Parts List

| Mark         | No.              | Part No.   | Description                 | Mark         | No.         | Part No.     | Description                                  |
|--------------|------------------|------------|-----------------------------|--------------|-------------|--------------|----------------------------------------------|
|              | 1.               | PNA-217    | Bonnet                      |              | 41.         | PNY-192      | Worm wheel                                   |
|              | 2.               | PNY-426    | Front door [PL-V70]         |              | 42.         | PBH-391      | Tension spring                               |
|              |                  | PNY-410    | Front door [PL-L90]         |              | 43.         | PLB-237      | Fixer                                        |
|              | 3.               | PNY-318    | Front panel                 |              | 44.         | PLB-259      | Guide bar                                    |
|              | 4.               | PXV-100    | Control panel unit [PL-V70] |              | 45.         | PXB-393      | Pulley assembly                              |
|              |                  | PXV-110    | Control panel unit [PL-L90] |              | 46.         | PNY-196      | Wire guide                                   |
|              | 5.               | PNY-321    | ADJ cover                   |              | 47.         | PNY-333      | Roller                                       |
|              | 6.               | PAD-169    | Power button unit [PL-V70]  |              | 48.         | PEC-095      | Cushion                                      |
|              |                  | PAD-186    | Power button unit [PL-L90]  |              | 49.         | PNX-424      | Roller                                       |
|              | 7.               | PAC-222    | Slide knob                  |              | 50.         | PNY-324      | Drive lever                                  |
|              | 8.               | PAC-223    | Selection button            |              | 51.         | PBH-413      | Drive lever spring                           |
|              | 9.               | PAC-224    | Mode button [PL-V70]        |              | 52.         | PNY-325      | Door holder (L)                              |
|              |                  | PAC-273    | Mode button [PL-L90]        |              | 53.         | PNY-326      | Door holder (R)                              |
|              | 10.              | PAC-225    | P/S button [PL-V70]         |              | 54.         | PBM-012      | Plastic rivet                                |
|              |                  | PAC-272    | P/S button [PL-L90]         |              | 55.         | PNY-327      | Lock lever                                   |
|              | 11.              | PAC-226    | Eject button [PL-V70]       |              | 56.         | PLM-011      | Roller ( $\phi 3 \times \phi 6 \times 7.1$ ) |
|              |                  | PAC-274    | Eject button [PL-L90]       |              | 57.         | PNY-328      | Switch lever                                 |
|              | 12.              | PBH-390    | Spring                      |              | 58.         | PBH-327      | Shutter spring                               |
|              | 13.              | PNY-312    | Slide base                  |              | 59.         | PNY-329      | Guide lever                                  |
|              | 14.              | PNR-218    | Turntable platter           |              | 60.         | PBH-414      | Guide lever spring (A)                       |
|              | 15.              | PEA-078    | Rubber mat assembly         |              | 61.         | PBH-415      | Guide lever spring (B)                       |
| $\star\star$ | 16.              | PYY-174    | Motor assembly              | $\Delta$     | 62.         | XWM-186      | Control board unit                           |
| $\star\star$ | 17.              | PEB-224    | Belt                        | $\Delta$     | 63.         | XWR-058      | Power supply board unit                      |
|              | 18.              | PXB-488    | Rotor assembly              |              | 64.         | XWS-040      | Switch board (B) unit                        |
|              | 19.              | PEB-298    | Spacer                      |              | 65.         | PWX-093      | Carriage board assembly                      |
| $\star\star$ | 20.              | PPD-679    | Tonearm assembly            |              | 66.         | PWX-094      | Mechanism base board assembly                |
|              | 21.              | PNY-332    | Sensor case                 | $\Delta$     | $\star$ 67. | PTX-064      | Power transformer assembly (120V)            |
|              | 22.              | PNP-335    | Band sensor board           | $\Delta$     | 68.         | PDF-221      | Power cord assembly                          |
| $\star\star$ | 23.              | PCX-059    | Photo transistor            |              | 69.         | PEC-087      | Strain relief                                |
| $\star$      | 24.              | NJL1102EH  | LED                         |              | 70.         | PDX-016      | PU cord assembly                             |
|              | 25.              | PBH-424    | Spring                      |              | 71.         | PEC-051      | Strain relief                                |
|              | 26.              | PLB-234    | Adjustment screw            | $\star\star$ | 72.         | PSH-007      | Slide switch                                 |
| $\star$      | 27.              | PR2222S-B1 | LED                         |              | 73.         | PEC-082      | Stopper                                      |
|              | 28.              | PNY-323    | Carriage                    |              | 74.         | PEB-299      | Float rubber                                 |
| $\star$      | 29.              | PXB-392    | Solenoid assembly           |              | 75.         | PBH-416      | Float spring (A)                             |
|              | 30.              | PBH-406    | Carriage spring             |              | 76.         | PBH-417      | Float spring (B)                             |
| $\Delta$     | $\star\star$ 31. | PXM-137    | Driving motor               |              | 77.         | PEC-099      | Insulator                                    |
|              | $\star\star$ 32. | PNX-498    | Motor pulley                |              | 78.         | PBA-144      | Screw                                        |
|              | 33.              | PEB-268    | Damper rubber               |              | 79.         | PEC-096      | Supporter                                    |
|              | 34.              | PNC-325    | Motor holder                |              | 80.         | N93-603      | 45 adaptor                                   |
|              | 35.              | PNY-190    | Pulley                      |              | 81.         | PMZ30P060FZK | Screw                                        |
|              | 36.              | PNY-191    | Slit plate                  |              | 82.         | WA21D040D025 | Washer                                       |
|              | 37.              | PNW-391    | Collar                      |              | 83.         | PSZ30P050FMC | Screw                                        |
| $\star\star$ | 38.              | PEB-097    | Belt                        |              | 84.         | PSZ30P060FZK | Screw                                        |
|              | 39.              | PNW-485    | Worm unit                   |              | 85.         | ISZ30P060FMC | Screw                                        |
|              | 40.              | PBF-021    | Washer                      |              |             |              |                                              |

| Mark | No.  | Part No.     | Description         | Mark | No.  | Part No. | Description               |
|------|------|--------------|---------------------|------|------|----------|---------------------------|
|      | 86.  | IPC30P100FMC | Screw               |      | 206. |          | .....                     |
|      | 87.  | PSZ30P060FZK | Screw               |      | 207. |          | Screw                     |
|      | 88.  | ISZ30P060FZK | Screw               |      | 208. |          | Front base                |
|      | 89.  | PMA40P060FMC | Screw               |      | 209. |          | Roller plate              |
|      | 90.  | PMB30P080FMC | Screw               |      | 210. |          | Slide rail assembly       |
|      | 91.  | iPZ30P120FMC | Screw               |      | 211. |          | Door angle                |
|      | 92.  | ISZ30P080FMC | Screw               |      | 212. |          | Slide base                |
|      | 93.  | WT21D040D025 | Washer              |      | 213. |          | Base unit                 |
|      | 94.  | CMZ30P040FZK | Screw               |      | 214. |          | .....                     |
|      | 95.  | PXV-963      | Cartridge           |      | 215. |          | Pin                       |
|      | 96.  | PNX-981      | Stylus holder       |      | 216. |          | Pin                       |
|      | 201. |              | Stopper             |      | 217. |          | Switch board (A) unit     |
|      | 202. |              | Motor pulley        |      | 218. |          | Switch board (C) unit     |
|      | 203. |              | ...                 |      | 219. |          | Transistor board (A) unit |
|      | 204. |              | Stopper             |      | 220. |          | Transistor board (B) unit |
|      | 205. |              | Mechanism base unit |      |      |          |                           |

8. PACKING



Parts List

| Mark | No. | Part No. | Description                     | Mark | No.  | Part No.     | Description         |
|------|-----|----------|---------------------------------|------|------|--------------|---------------------|
|      | 1.  | PRB-290  | Operating instructions [PL-V70] |      | 9.   | PNY-331      | Carriage clamber    |
|      |     | PRB-291  | Operating instructions [PL-L90] |      | 10.  | N93-603      | 45 adaptor          |
|      | 2.  | PDE-319  | PU cord                         |      | 11.  | PEA-078      | Rubber mat assembly |
|      | 3.  | PHH-257  | Packing case [PL-V70]           |      | 12.  | PNR-218      | Turntable platter   |
|      |     | PHH-258  | Packing case [PL-L90]           |      | 13.  | PHL-034      | Sheet               |
|      | 4.  | PHA-192  | Protector (F)                   |      | 14.  | PHC-115      | Door spacer         |
|      | 5.  | PHA-193  | Protector (R)                   |      | 15.  | RRG-025      | Sheet [PL-V70]      |
|      | 6.  | PNY-330  | Spacer                          |      | 16.  | iPZ30P120FMC | Screw               |
|      | 7.  | PBA-118  | Screw                           |      | 101. |              | Caution card        |
|      | 8.  | PBA-141  | Screw                           |      |      |              |                     |

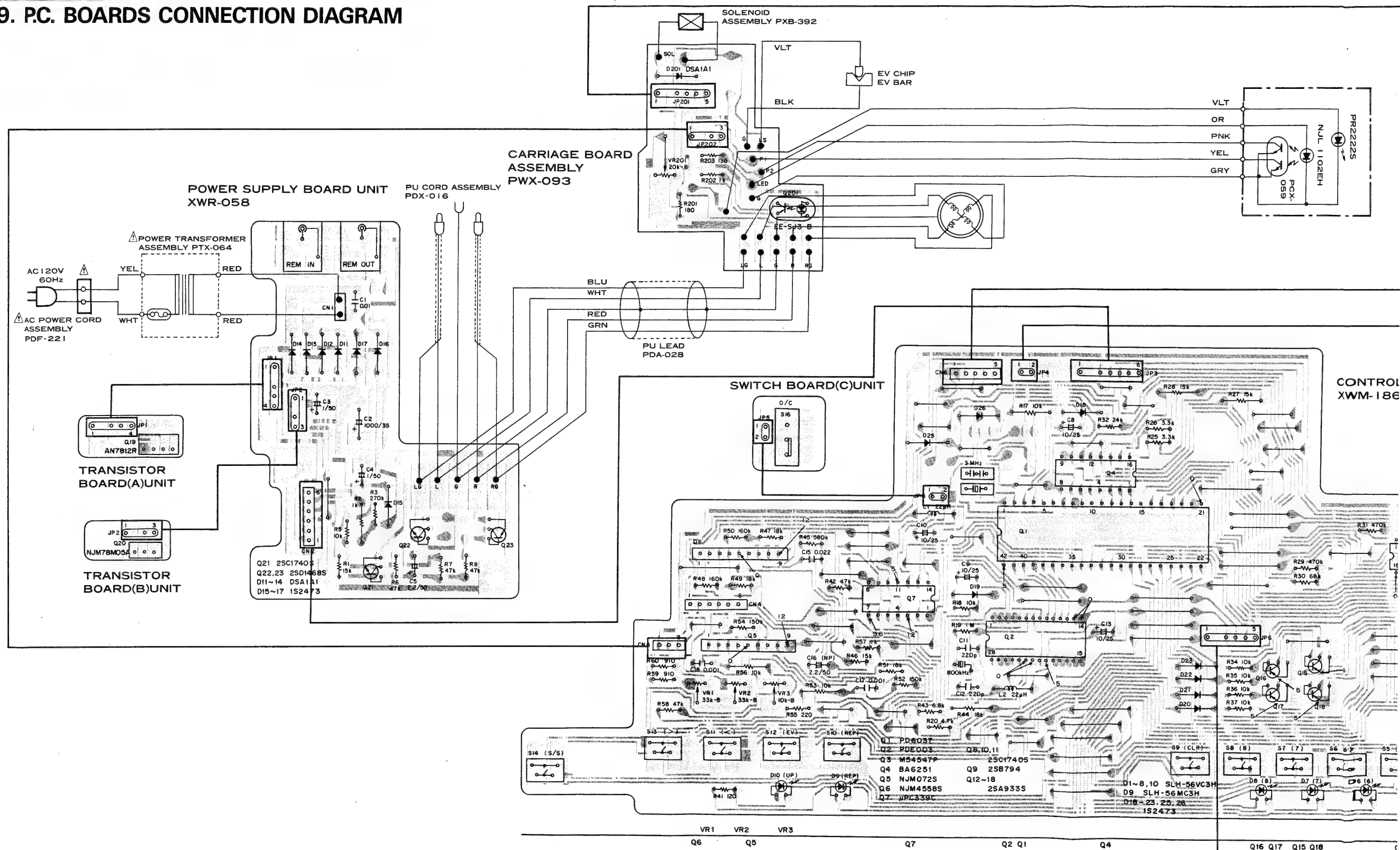
## 9. PC. BOARDS CONNECTION DIAGRAM

A

B

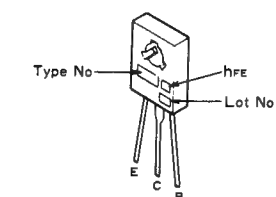
C

D

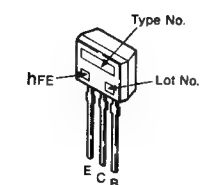




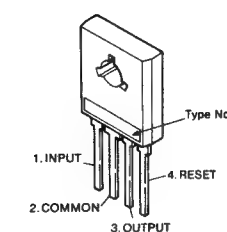
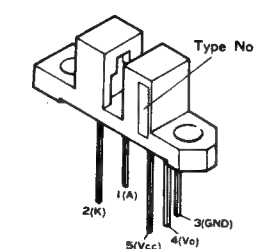
2SB794



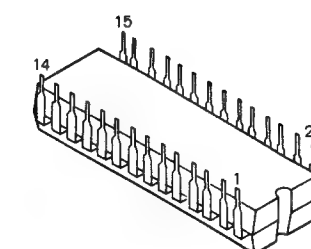
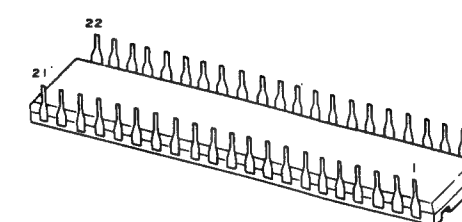
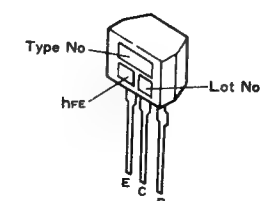
2SD1468S



AN7812R



PDE003



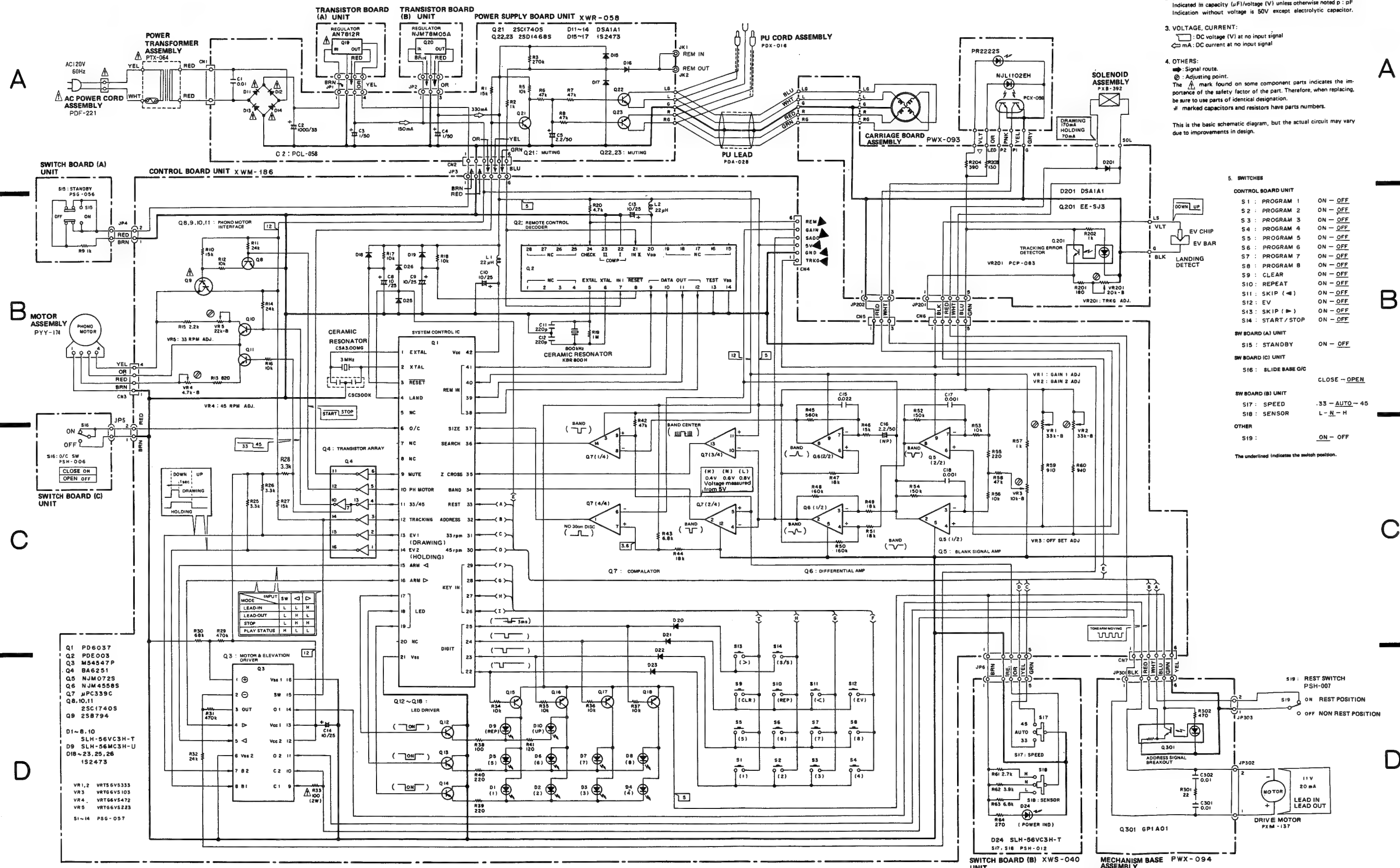
A

E

C

4

## 10. SCHEMATIC DIAGRAM



11. ELECTRICAL PARTS LIST

- NOTES:
- When ordering resistors, first convert resistance values into code form as shown in the following examples.  
Ex. 1 When there are 2 effective digits (any digit apart from 0), such as 560 ohm and 47k ohm (tolerance is shown by J=5%, and K=10%).  
560Ω 56 × 10<sup>1</sup> 561..... RD4PS 561 J  
47kΩ 47 × 10<sup>3</sup> 473..... RD4PS 473 J  
0.5Ω 0R5 ..... RN2H 0R5 K  
1Ω 010 ..... RS1P 010 K  
Ex. 2 When there are 3 effective digits (such as in high precision metal film resistors).  
5.62kΩ 562 × 10<sup>1</sup> 5621 .... RN4SR 5621 F  
The  $\Delta$  mark found on some component parts indicates the importance of the safety factor of the part. Therefore, when replacing, be sure to use parts of identical designation.  
For your Parts Stock Control, the fast moving items are indicated with the marks **★★** and **★**.  
**★★ GENERALLY MOVES FASTER THAN ★**  
This classification shall be adjusted by each distributor because it depends on model number, temperature, humidity, etc.

Miscellaneous Parts

| Mark        | Symbol & Description              | Part No.   |
|-------------|-----------------------------------|------------|
| $\Delta$    | Control board unit                | XWM-186    |
|             | Power supply board unit           | XWR-058    |
|             | Switch board (A) unit             |            |
|             | Switch board (B) unit             | XWS-040    |
|             | Switch board (C) unit             |            |
|             | Transistor board (A) unit         |            |
|             | Transistor board (B) unit         |            |
|             | Carriage board assembly           | PWX-093    |
|             | Mechanism base board assembly     | PWX-094    |
| $\Delta$ ★  | Power transformer assembly (120V) | PTX-064    |
| $\Delta$ ★★ | Power cord assembly               | PDF-221    |
| ★★          | Motor assembly                    | PYY-174    |
| ★★          | Driving motor                     | PXM-137    |
| $\Delta$ ★  | Solenoid assembly                 | PXB-392    |
| ★★          | Photo transistor                  | PCX-059    |
| ★           | LED                               | NJL1102EH  |
| ★           | LED                               | PR2222S-B1 |

Control Board Unit (XWM-186)

| Mark                  | Symbol & Description | Part No.   |
|-----------------------|----------------------|------------|
| ★★ Q1                 |                      | PD6037     |
| ★★ Q2                 |                      | PDE003     |
| ★★ Q3                 |                      | M54547P    |
| ★★ Q4                 |                      | BA6251     |
| ★★ Q5                 |                      | NJM072S    |
| ★★ Q6                 |                      | NJM4558S   |
| ★★ Q7                 |                      | μPC339C    |
| $\Delta$ ★★ Q9        |                      | 2SB794     |
| ★★ Q12 - Q18          |                      | 2SA933S    |
| ★★ Q8, Q10, Q11, Q21  |                      | 2SC1740S   |
| ★ D18 - D23, D25, D26 |                      | 1S2473     |
| ★ D1 - D8, D10        |                      | SLH-56VC3H |
| ★ D9                  |                      | SLH-56MC3H |

SWITCHES

| Mark        | Symbol & Description | Part No. |
|-------------|----------------------|----------|
| ★★ S1 - S14 | Tact switch          | PSG-057  |

COILS

| Mark | Symbol & Description | Part No.   |
|------|----------------------|------------|
|      | L1, L2               | LAL03T220K |

CAPACITORS

| Mark | Symbol & Description | Part No.    |
|------|----------------------|-------------|
|      | C16                  | CEANP2R2M50 |
|      | C8 - C10             | CEA100M25   |
|      | C17                  | CKDYB102K50 |
|      | C15                  | CKDYF223Z50 |
|      | C11, C12             | CCDSL221J50 |

RESISTORS

NOTE: When ordering resistors, convert the resistance value into code form, and then rewrite the part no. as before.

| Mark       | Symbol & Description | Part No.     |
|------------|----------------------|--------------|
| ★ VR1, VR2 | Semi-fixed 33k-B     | VRTS6VS333   |
| ★ VR3      | Semi-fixed 10k-B     | VRTG6VS103   |
| ★ VR4      | Semi-fixed 47k-B     | VRTG6VS472   |
| ★ VR5      | Semi-fixed 22k-B     | VRTG6VS223   |
|            | R33                  | RS2LMF101J   |
|            | Other resistors      | RD1/6PM □□□J |

Control Board Unit (XWM-186)

OTHERS

| Mark | Symbol & Description | Part No.  |
|------|----------------------|-----------|
| ★    | Ceramic resonator    | CSA3.00MG |
| ★    | Ceramic resonator    | CSC300K   |
| ★    | Ceramic resonator    | KBR-800H  |

Power Supply Board Unit (XWR-058)

SEMICONDUCTORS

| Mark                 | Symbol & Description | Part No.        |
|----------------------|----------------------|-----------------|
| ★★ Q21               |                      | 2SC1740S        |
| ★★ Q22, Q23          |                      | 2SD1468S        |
| $\Delta$ ★ D11 - D14 |                      | DSA1A1 (DSA1A2) |
| ★ D15, D16, D17      |                      | 1S2473          |

CAPACITORS

| Mark | Symbol & Description | Part No.    |
|------|----------------------|-------------|
|      | C3, C4               | CEA1R0M50   |
|      | C5                   | CEA2R2M50   |
|      | C2                   | PCL-058     |
|      | C1                   | CKDYF103Z50 |

RESISTORS

NOTE: When ordering resistors, convert the resistance value into code form, and then rewrite the part no. as before.

| Mark | Symbol & Description | Part No.     |
|------|----------------------|--------------|
|      | R1 - R3, R5 - R8     | RD1/6PM □□□J |

OTHERS

| Mark | Symbol & Description | Part No. |
|------|----------------------|----------|
|      | JK1, JK2 Terminal    | RKN-071  |

Switch Board (A) Unit

SWITCH

| Mark   | Symbol & Description | Part No. |
|--------|----------------------|----------|
| ★★ S15 | Switch (POWER)       | PSG-056  |

Switch Board (B) Unit (XWS-040)

SWITCHES

| Mark        | Symbol & Description   | Part No. |
|-------------|------------------------|----------|
| ★★ S17, S18 | Switch (SPEED, SENSOR) | PSH-012  |

Switch Board (C) Unit

SWITCH

| Mark   | Symbol & Description | Part No. |
|--------|----------------------|----------|
| ★★ S16 | Switch (O/C)         | PSH-006  |

Transistor Board (A) Unit

SEMICONDUCTOR

| Mark            | Symbol & Description | Part No. |
|-----------------|----------------------|----------|
| $\Delta$ ★★ Q19 |                      | AN7812R  |

Transistor Board (B) Unit

SEMICONDUCTOR

| Mark   | Symbol & Description | Part No.  |
|--------|----------------------|-----------|
| ★★ Q20 |                      | NJM78M05A |

Carriage Board Assembly (PWX-093)

SEMICONDUCTORS

| Mark    | Symbol & Description | Part No.            |
|---------|----------------------|---------------------|
| ★★ Q201 |                      | EE-SJ3-B            |
| ★ D201  |                      | DSA1A1 (1SR35-100A) |

RESISTORS

NOTE: When ordering resistors, convert the resistance value into code form, and then rewrite the part no. as before.

| Mark    | Symbol & Description | Part No.     |
|---------|----------------------|--------------|
| ★ VR201 | Semi-fixed 10k-B     | PCP-083      |
|         | R201 - R204          | RD1/6PM □□□J |

Mechanism Base Board Assembly (PWX-094)

SEMICONDUCTOR

| Mark    | Symbol & Description | Part No. |
|---------|----------------------|----------|
| ★★ Q301 |                      | GP-1A01  |

CAPACITORS

| Mark | Symbol & Description | Part No.    |
|------|----------------------|-------------|
|      | C301, C302           | CKDYF103Z50 |

RESISTORS

NOTE: When ordering resistors, convert the resistance value into code form, and then rewrite the part no. as before.

| Mark | Symbol & Description | Part No.     |
|------|----------------------|--------------|
|      | R301, R302           | RD1/6PM □□□J |

## 12. ADJUSTMENT

### 12.1 STYLUS LOWERING POSITION ADJUSTMENT

1. With the power ON place a test record (PLS-2001) or PLS-4001 side A up) on the turntable.
  2. Press the PLAY/STOP button and check the position of the tonearm as it comes to rest on the record.
  3. Remove the bonnet cover and turn the adjustment screw ① until the tonearm comes into line with the record.
- When the tonearm comes to rest to the right of the lead-in groove, (when the count is lower than the standard count tolerance) turn the adjustment screw ① counterclockwise.
  - When the tonearm comes to rest to the left of the lead-in groove, (when the count is higher than the standard count tolerance) turn the adjustment screw ① clock-wise.
  - When using the test record the position will be set for 30cm records.

| Test record | Adjustment position |
|-------------|---------------------|
| PLS2001     | $310 \pm 3$ counts  |
| PLS4001     | $13 \pm 6$ counts   |

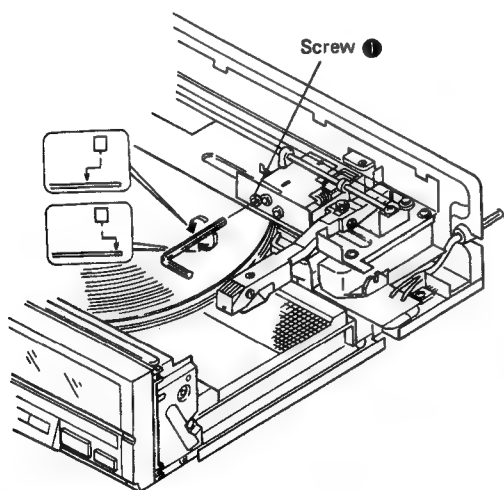


Fig. 12-1 Stylus Lowering Position Adjustment

### 12.2 TRACKING SENSOR AND OFFSET ADJUSTMENT

#### ● Gain Adjustment

1. Remove the bonnet cover and turntable platter.
2. Connect a DC voltmeter to CN4 pin 2 (GND) and pin 1 (TRKG).
3. Turn screw ② counterclockwise and pull the carriage unit forward.
4. Turn on the power and while pushing the tone arm toward the center (as shown in the illustration) adjust VR201 (TRKG) until the DC voltmeter registers  $3V \pm 0.1V$ .

#### ● Offset Adjustment

5. Return the tonearm to the rest position. (It will return by itself when you release it.)
6. To adjust it, turn screw ③ clockwise until the DC voltmeter registers  $1.1V \pm 0.1V$ .

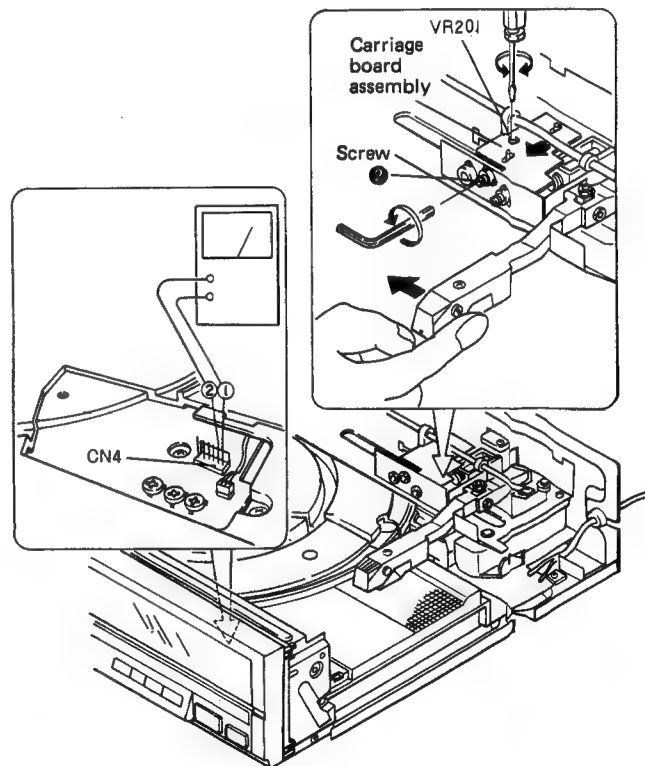


Fig. 12-2 Tracking Sensor Gain and Offset Adjustment

**Note:**

The adjustments described in 12.1 and 12.3 can be performed without removing the bonnet cover. To do so, set S16 to ON using a spacer as described in 12.4.

### 12.3 STYLUS HEIGHT ADJUSTMENT

1. Remove the bonnet cover.
2. Place a 30cm record on the turntable, turn on the power, and using the locate switch ( < ) move the tonearm to within approximately 100mm of the center of the turntable.
3. Turn screw ③ until the tip of the needle is 5 to 7mm above the surface of the record.
  - Turning the screw clockwise lowers the needle.
  - Turning the screw counterclockwise raises the needle.

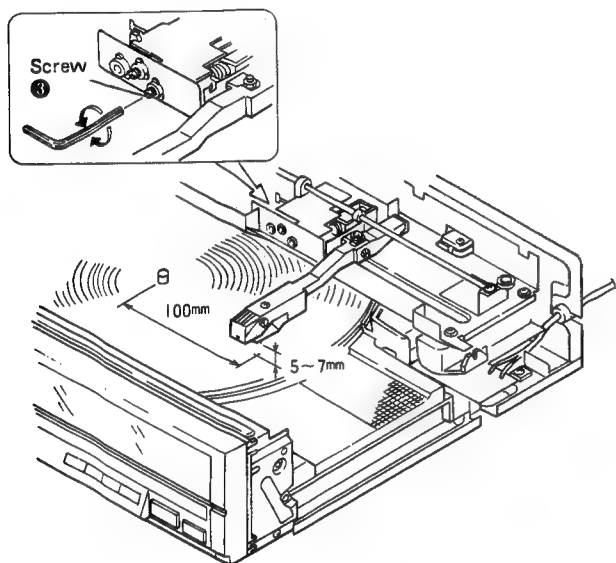


Fig. 12-3 Stylus Height Adjustment

### 12.4 BAND SENSOR OFFSET ADJUSTMENT

1. Turn the power off, and move the slide base to the out position. Remove the turntable and associated parts and the ADJ cover, then pull out CN5.
2. Set S16 (O/C switch) to ON by inserting a spacer (e.g., a female 8P connector) between the slide base and the lock lever beneath the slide base.
3. Turn the power on, and turn VR1 and VR2 counterclockwise (seen from the top) to the extreme left.
4. Adjust VR3 (offset) so that the voltage between pins 3 and 4 of CN4(TP) (5V — SADO) falls within  $0 \pm 30$  mV.
5. Reconnect CN5 after adjustment is completed.

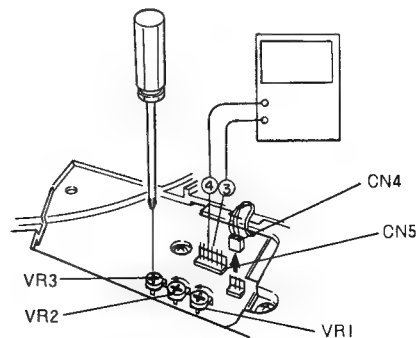
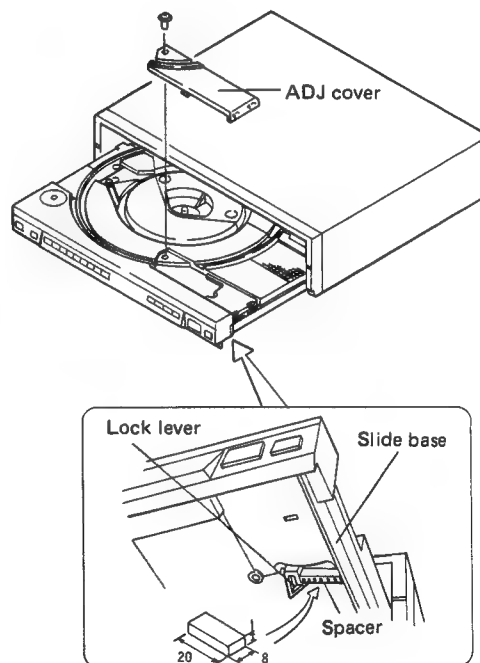


Fig. 12-4 Band Sensor Offset Adjustment

## 12.5 BAND SENSOR GAIN ADJUSTMENT

1. Turn off the power, plug in CN5, and connect an AC voltmeter to pins 3 (5V) and 5 (GAIN) of CN4(TP).
2. After placing test record PLS-4001 on the turntable with side B up (the grooveless side), place the notched rubber gain adjustment sheet (MLB-3199) on top of that.
3. Turn on the power and set the speed to 45 rpm. Using the locate switch ( < ), move the tonearm over the center of the slits in the notched rubber sheet as shown in figure 12-5.
4. Adjust VR1 (GAIN 1) so that the AC voltmeter reads  $55 \pm 3$  mVAC.
5. Move the tonearm outside of the turntable using the locate switch ( > ), and remove the notched rubber sheet. Then return the tonearm to the same position as before using the locate switch ( < ).
6. Connect a DC voltmeter or oscilloscope between pin 3 (5V) and pin 4 (SADO) of CN4(TP).
7. Adjust VR2 (GAIN 2) so that the DC voltmeter or oscilloscope reads  $0 \pm 30$  mV.

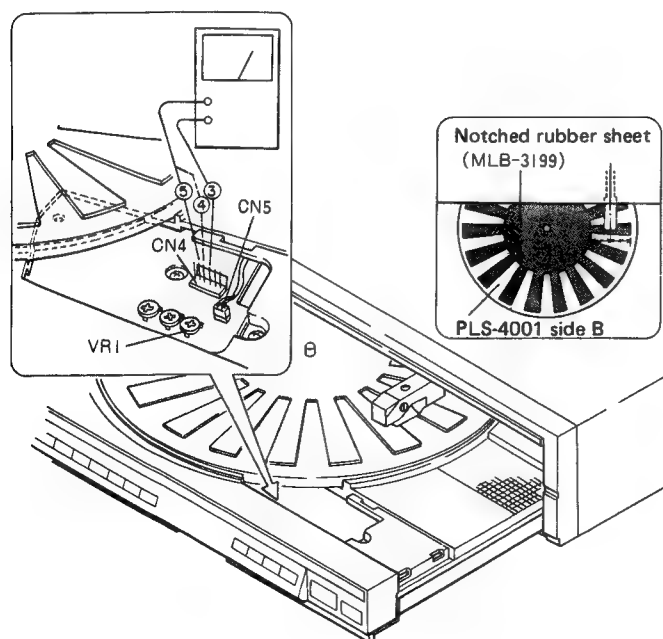


Fig. 12-5 Band Sensor Gain Adjustment

## 12.6 PROGRAM SELECTION ADJUSTMENT

1. Set the sensor sensitivity switch to "H", and place test record PLS-4001S side A up on the turntable.
2. Set the program switch to selection number 2 and selection number 7.
3. After the needle has come to rest in the band before selection 2, make sure that there is a 3 – 4 second 1 kHz tone. Adjust the tonearm if it doesn't come to rest within the band.
4. To adjust it, push the EV button and raise the tonearm. Turn the adjustment screw until the needle comes to rest within the band.
5. To check that adjustment is correct, bring the tonearm DOWN and press the SKIP ( > ) switch.
  - If the needle comes down in the previous selection (the 1 kHz tone is too short) turn the screw clockwise.
  - If the needle comes down in the previous selection (the 1 kHz tone is too short) turn the screw clockwise.
6. After adjusting the tonearm, push the SKIP button ( < ) and make sure that there is a 1 kHz signal before selection number 7.

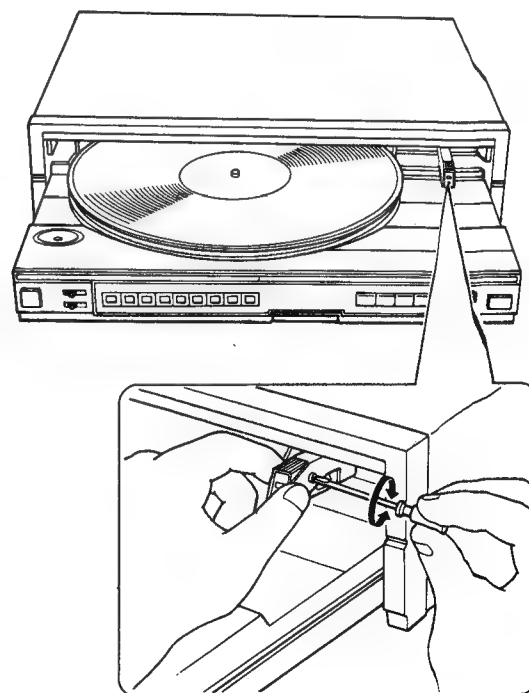


Fig. 12-6 Program Selection Adjustment

## 12.7 PHONO MOTOR SPEED ADJUSTMENT

1. Turn the power on with a strobo-sheet on the turntable. And turn the locate switch ( > ) on to activate the phono motor.
2. Insert a small driver from beneath the panel through the speed adjustment hole, and turn the small driver to adjust each turntable speed.

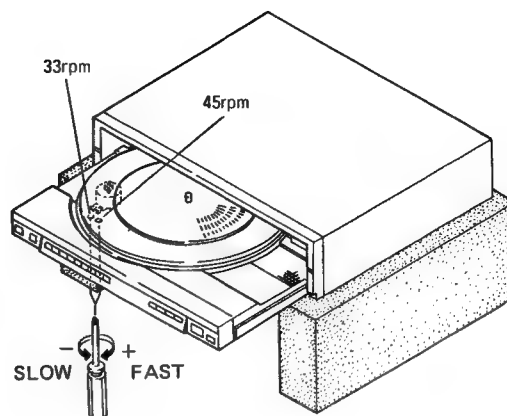


Fig. 12-7

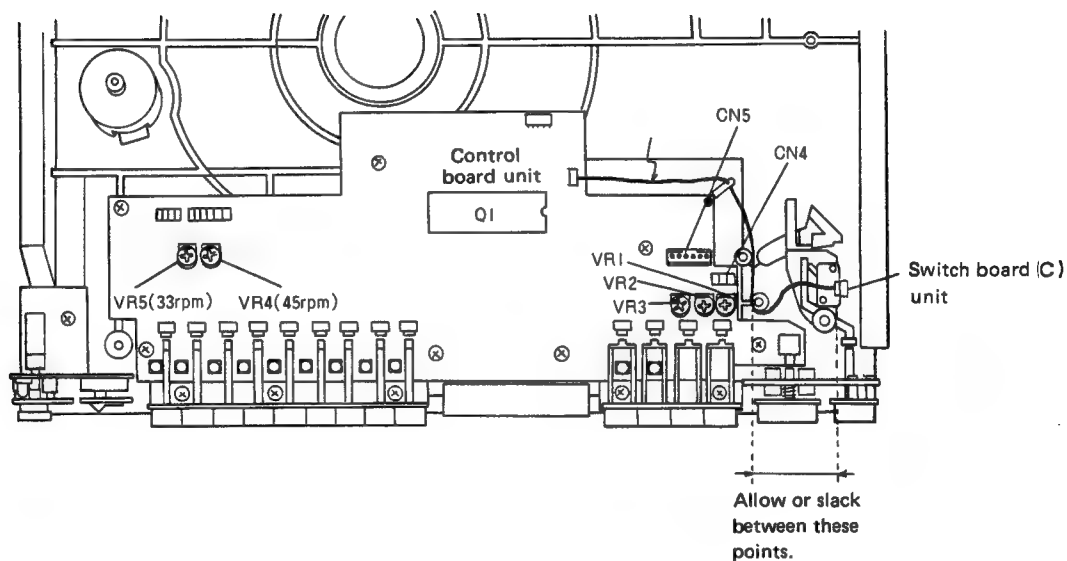
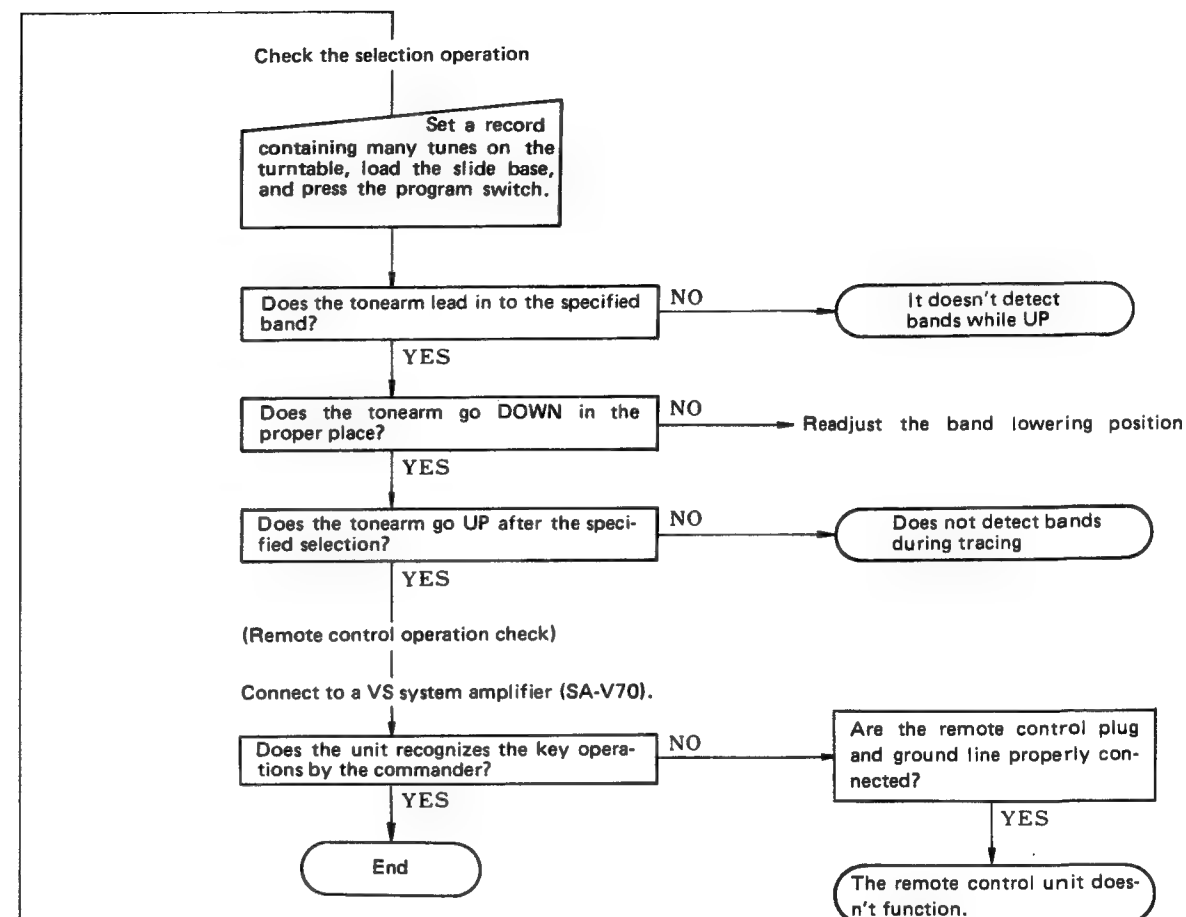
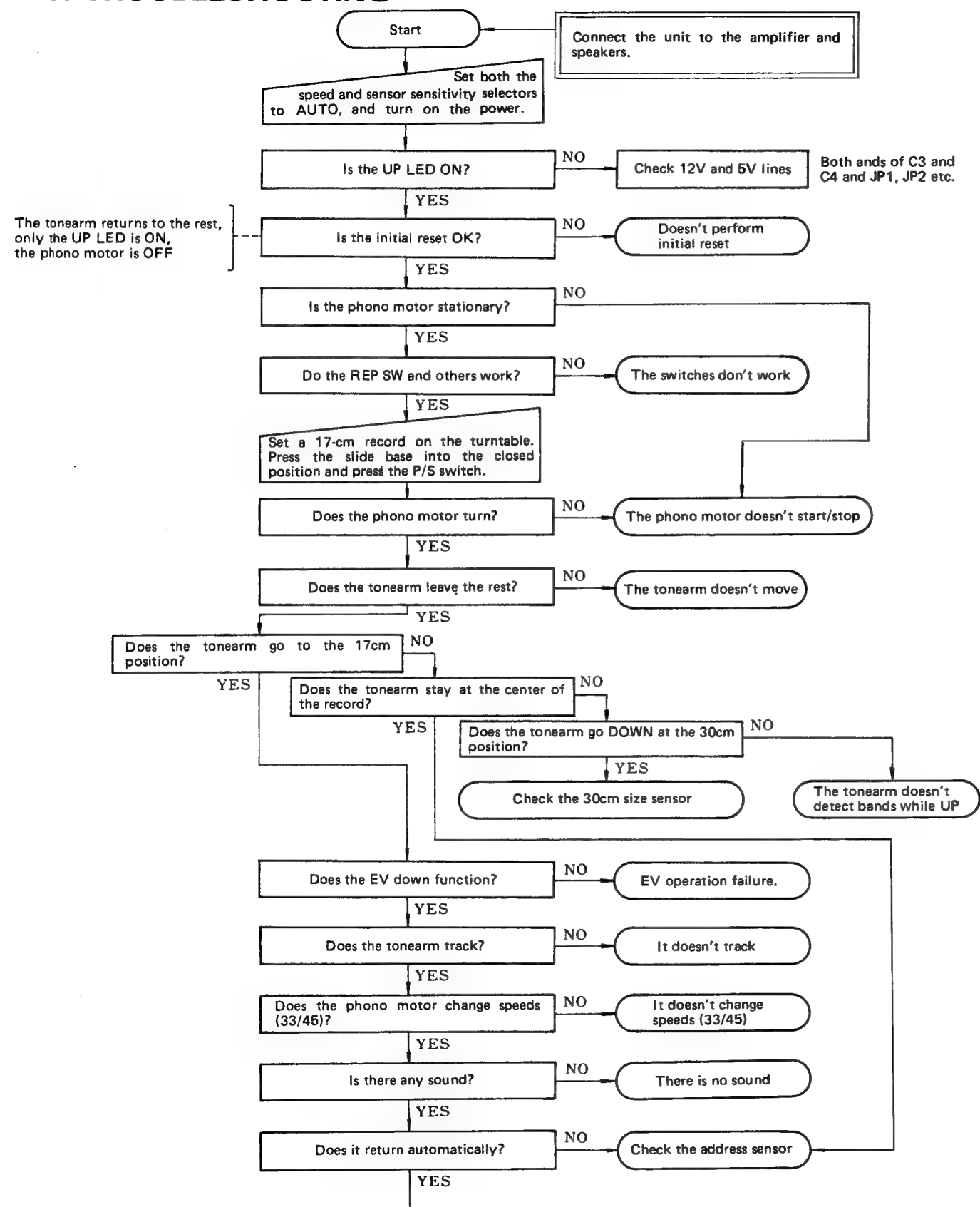
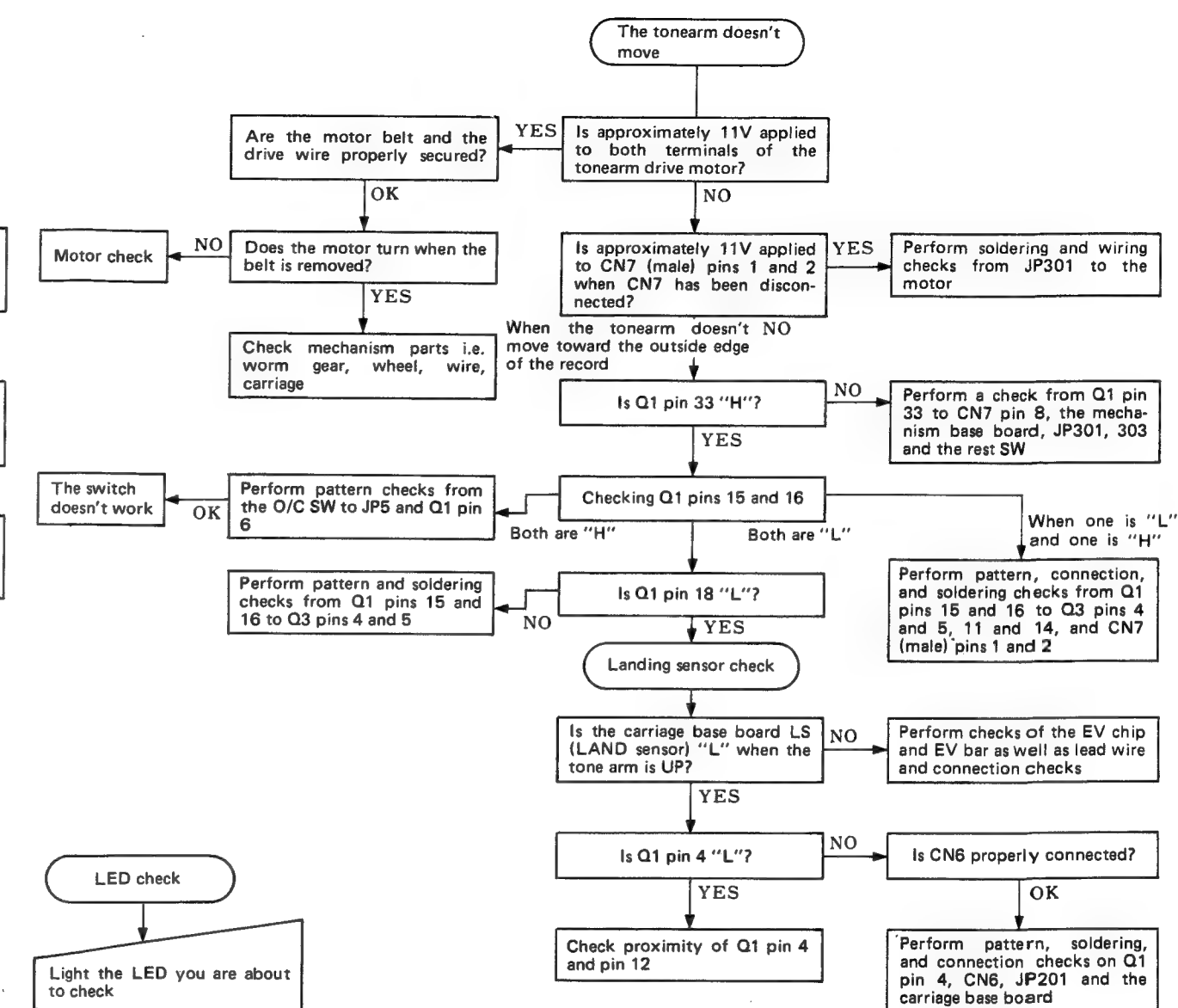
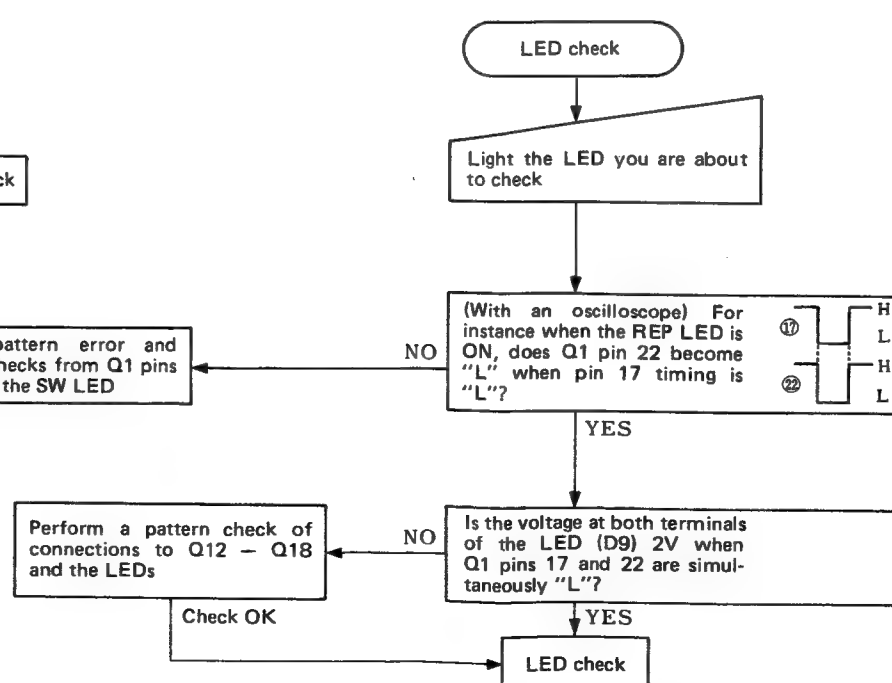
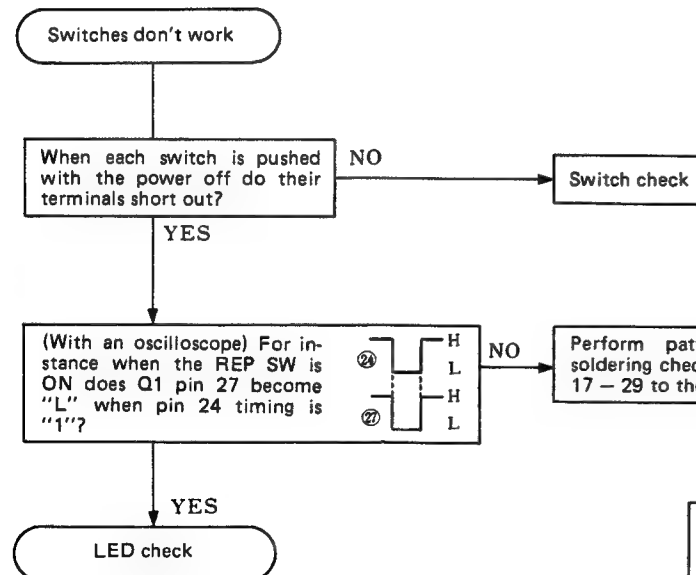
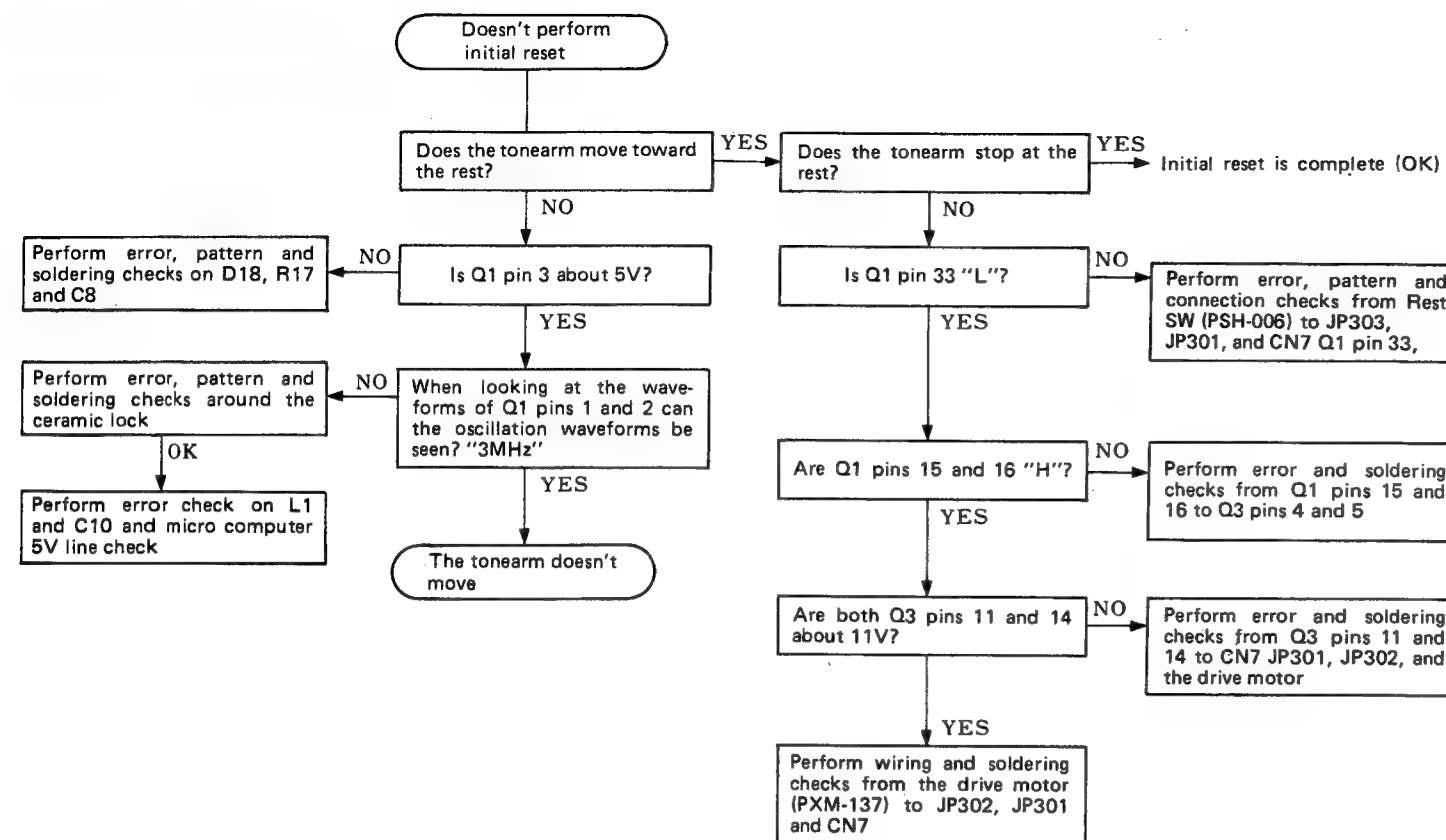


Fig. 12-8 Adjust point

## 13. TROUBLESHOOTING

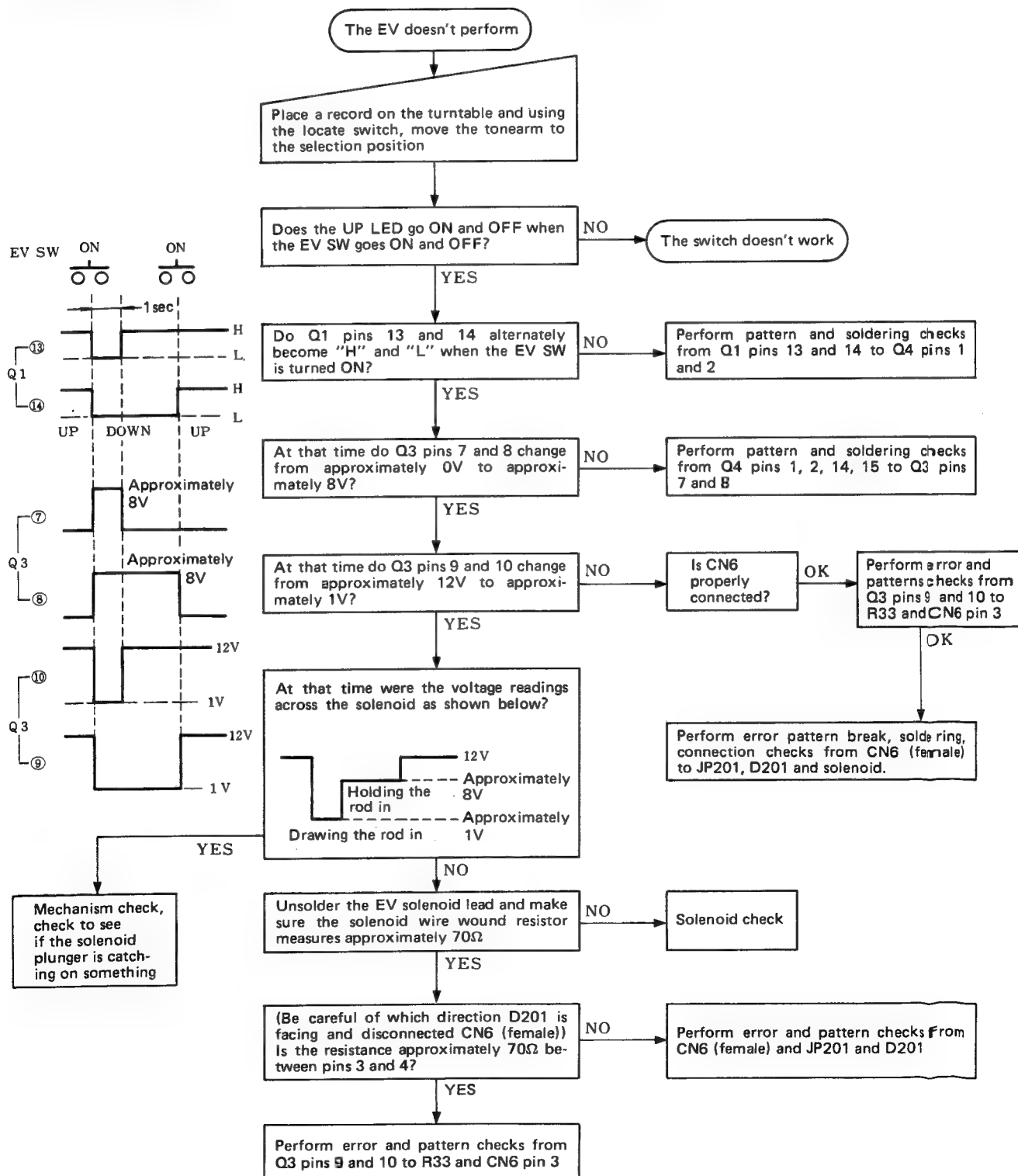


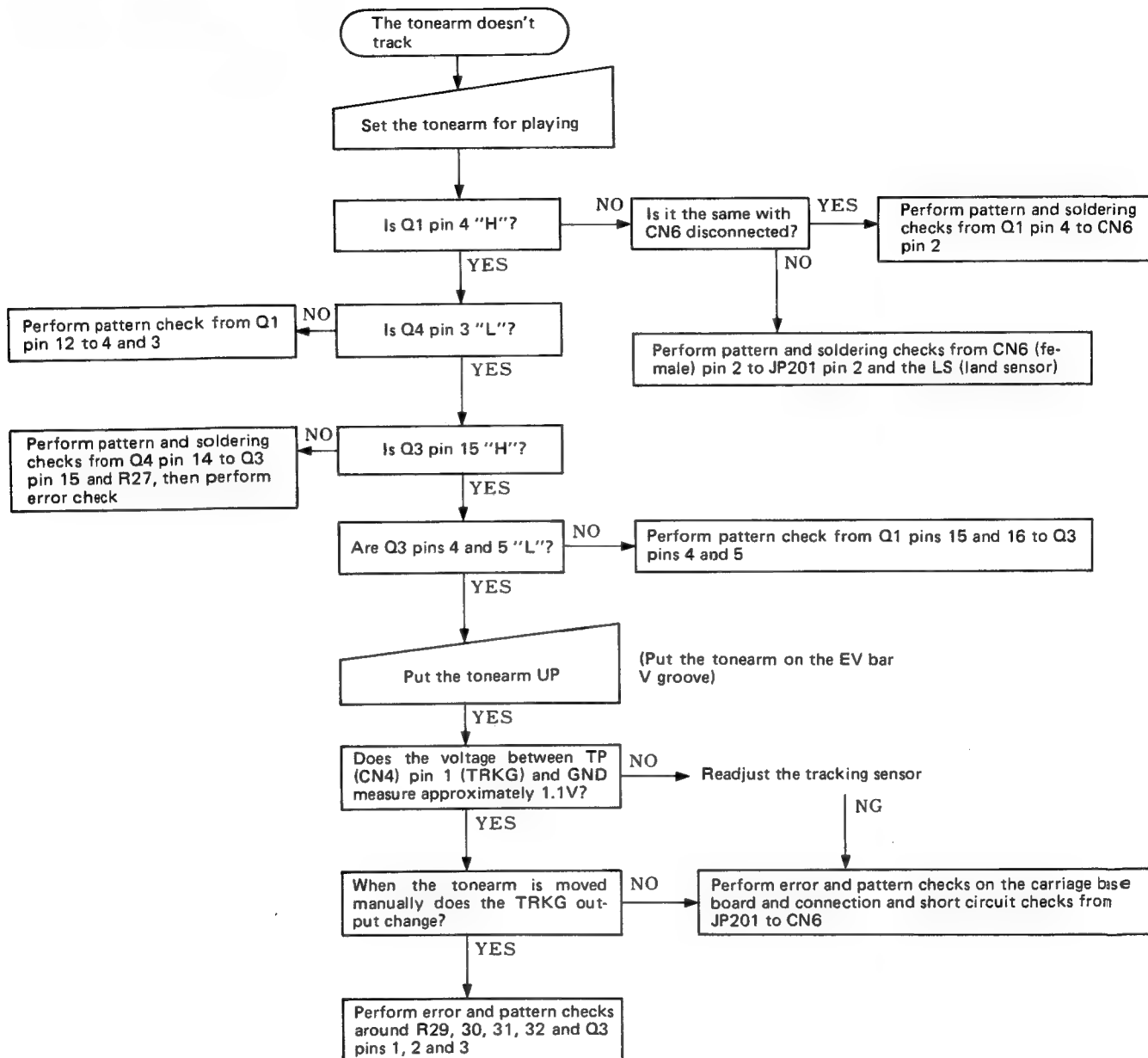


Notes:

- The EV is up while the tonearm is on the arm rest (or while the slide base is in the out position), and will not go down in that state.
- If an operation other than "locate" occurs while the slide base is in the out position,

chances are that the lead line between the SW board (C) unit and the control board unit is tight. When attaching units such as the SW control board, therefore, allow a slack in the lead line. (See figure 12-8 on page 52)





TT: turntable

